# AIRS/AMSU/HSB Version 4.0
# Data Release User Guide

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**Submit Questions to:**
http://airs-inquiry.jpl.nasa.gov/feedback/feedback_form.cfm

# Table of Contents

# Table of Figures

# Introduction

The Atmospheric Infrared Sounder (AIRS) instrument suite is designed to measure the Earth's atmospheric water vapor and temperature profiles on a global scale. It is comprised of a space-based hyperspectral infrared instrument (AIRS) and two multichannel microwave instruments, the Advanced Microwave Sounding Unit (AMSU-A) and the Humidity Sounder for Brazil (HSB). The AIRS instrument suite is one of several instruments onboard the Earth Observing System (EOS) Aqua spacecraft launched May 4, 2002. The Aqua spacecraft orbit is polar sun-synchronous with a nominal altitude of 705 km and an orbital period of 98.8 minutes. The repeat cycle period is 233 orbits (16 days) with a ground track repeatability of +/- 20 km. The platform equatorial crossing local times are 1:30 in the morning (descending) and 1:30 in the afternoon (ascending). For orbit track information, see the URL:

| | |
|---|---|
| **Aqua orbit track information** | http://www.ssec.wisc.edu/datacenter/aqua/ |

Operational L1B, L2 and L3 Products of the AIRS/AMSU/HSB instrument suite on the EOS Aqua spacecraft are now available for use by the general public. They can be accessed on the web at the URLs:

| | |
|---|---|
| **GSFC DAAC Data Pool** | http://daac.gsfc.nasa.gov/data/datapool/AIRS_DP |
| **GSFC DAAC WHOM** | http://daac.gsfc.nasa.gov/data/dataset/AIRS |

These data are in the standard HDF-EOS v4 swath format. See

| | |
|---|---|
| **NCSA HDF 4.2 Reference** | http://hdf.ncsa.uiuc.edu/rel4links.html |
| **HDF-EOS Tools and Information** | http://hdfeos.gsfc.nasa.gov/hdfeos/index.cfm |

All data are released to the public. However, the state of product validation depends upon surface type, latitude and product type. Please read the Disclaimer the Validation Report, and refer to the V4 Validation Status Summary:

**V4.0_Data_Disclaimer.pdf**

**V4.0_Validation_Report.pdf**

**V4_CalVal_Status_Summary.pdf**

The L1B data include geolocated, calibrated observed radiances, Quality Assessment (QA) data and global browse images. The radiances are well calibrated; however, not all QA data have been validated.

The L2 data include geolocated, calibrated cloud-cleared radiances and 2-dimensional and 3-dimensional retrieved physical quantities (e.g., surface properties and temperature, moisture and ozone profiles throughout the atmosphere). Global browse images are also included. Each product granule contains 6 minutes of data. Thus there are 240 granules of each product produced every day.

A complete description of the contents of the product files may be found in the companion document titled "AIRS Version 4.0 Released Files Description". A PDF file containing Version 1.0 of this document (JPL D-31231), dated February 2005, accompanies this document:

**V4.0_Release_ProcFileDesc.pdf**

The document provides for each product:
- Dimensions for use in HDF-EOS swath fields (name, value, explanation)
- Geolocation fields (name, explanation)
- Attributes (name, type, extra dimensions, explanation)
- Along-track data fields (name, type, extra dimensions, explanation)
- Swath data fields (name, type, extra dimensions, explanation)
- Special AIRS types for engineering data fields (name, type, explanation)

It also provides the product file naming and local granule identification (LGID) conventions used in the identifier portion of the EOSDIS Core System (ECS) and a table of all current Science, Engineering and Browse Products (L1A, L1B and L2).

Descriptions of the data products provided in that document and instrument and data features provided here are limited to the V4.0 released data set. For additional information, please consult the AIRS public web site. You may submit a question to the Ask AIRS link there:

| | |
|---|---|
| **AIRS Public Web site** | http://airs.jpl.nasa.gov/. |
| **Ask AIRS** | http://airs-inquiry.jpl.nasa.gov/feedback/feedback_form.cfm |

Additional information may be accessed at the following web sites:

| | |
|---|---|
| **AIRS Data Support** | http://daac.gsfc.nasa.gov/atmodyn/airs/. |
| **AIRS ATBDs** | http://eospso.gsfc.nasa.gov/eos_homepage/for_scientists/atbd/viewInstrument.php?instrument=2 |

# SIGNIFICANT CHANGES FROM V3.0 TO V4.0

## Level 3 Gridded Product Added

V4.0 includes a Level 3 gridded product, derived from the Level 2 swath product and binned at a resolution of 1° x 1° daily, over 8 days and over calendar month. Users of Level 3 Data Products are strongly urged to read the L3 QuickStart document:

**V4.0_L3_QuickStart.pdf**

## Level 2 Quality Flags

In the V3.0 release, we recommended that users filter the data contained within the Level 2 Standard Product by consulting RetQAFlag and using only those fields-of-view (FOVs) for which this quality flag is zero. As a result, entire FOVs are excised from consideration. This is still a valid means of identifying the highest quality retrievals in the V4.0 release and the casual user may employ this simple quality test to select data.

In the V4.0 release, a set of quality flags has been provided to inform the user separately about the quality of the retrieval of various products in three altitude regimes. The user who carefully employs these flags will substantially increase the sample size of various retrieved parameters. Please read the Level 2 Quality Flags Quick Start documentation for a description of these flags.

**V4.0_L2_QualFlag_QuickStart.pdf**

## Collection 3 (no HSB) and Collection 4 (with HSB)

The HSB instrument ceased operation on February 5, 2003 due to a mirror scan motor failure. Release V4.0 of AIRS Data Products provide two collections up to the date of HSB failure, and a single collection thereafter.

- Collection 3 data products are those produced with no HSB data.
- Collection 4 data products are those produced with HSB data included.

Level 2 AIRS Data Product file naming convention has been modified with release V4.0 to allow users to easily determine whether the data include HSB or not.

AIRS Level 2 Standard Product produced without using HSB (Collection 3)
AIRS.2002.09.06.183.L2.RetStd.v4.0.9.0.G04283152315.hdf

AIRS Level 2 Standard Product produced using HSB (Collection 4)
AIRS.2002.09.06.183.L2.RetStd.v4.0.9.0.HSB.G04283152315.hdf

See Appendix B of **V4_Release_Proc_FileDesc.pdf** for a complete description of the AIRS Data Product file name and local granule ID (LGID) convention.

### Compression of AIRS L1B and L2 Cloud Cleared Radiance Products

We are responding to user feedback highlighting the difficulty of downloading the large infrared radiance products in the V4 data release. The IEEE 32-bit floating point format provides precision beyond the measurement precision. Thus the least significant bits are filled with uncorrelated instrument and computational noise. We dynamically determine how many bits to keep for each channel in a granule based on current noise levels. We reduce the size of the files by rounding the stored values to remove these uncorrelated noise least significant bits of the mantissa, zeroing them to retain IEEE 32-bit format and then exercising the internal HDF-EOS compression technique, deflate. Deflate is a lossless compression technique algorithmically identical to gzip. Internal HDF-EOS compression is transparent to the user, with little or no impact on I/O throughput. The data files that result are half the size of the V3 release but still store the radiances in IEEE 32 bit floating point format for ease of use. An added benefit is longer retention period on the GSFC DAAC Data Pool and more rapid backlog processing of older data.

### Removal of Nighttime (Descending) VIS/NIR Products

The Visible/Near Infrared data products are not valid for the nighttime portion of the orbit and were filled with -9999 in V3.0. As there is no point in producing data product files completely filled with invalid data, we have completely removed the VIS/NIR data products during nighttime (descending).

# Instrument Description and Status

## *Overview*

The AIRS/AMSU/HSB instrument suite has been constructed to obtain atmospheric temperature profiles to an accuracy of 1 K for every 1 km layer in the troposphere and an accuracy of 1 K for every 4 km layer in the stratosphere up to an altitude of 40 km. The temperature profile accuracy in the troposphere matches that achieved by radiosondes launched from ground stations. The advantage of the AIRS suite in orbit is the provision of rapid <u>global</u> coverage; radiosonde coverage of the Earth's oceans is practically nonexistent. In conjunction with the temperature profiles, the AIRS instrument suite obtains humidity profiles to an accuracy of 10% in 2 km layers in the lower troposphere

and an accuracy of ~50% in the upper troposphere. It also provides integrated column burden for several trace gases.
Summary descriptions of the instruments are available at the URL:

| | |
|---|---|
| **Instrument Description** | http://airs.jpl.nasa.gov/technology/technology_index.html |

## *Description of Instruments*

### AIRS

AIRS is a continuously operating cross-track scanning sounder, consisting of a telescope that feeds an echelle spectrometer. The AIRS infrared spectrometer acquires 2378 spectral samples at resolutions, $\lambda/\Delta\lambda$, ranging from 1086 to 1570, in three bands: 3.74 µm to 4.61 µm, 6.20 µm to 8.22 µm, and 8.8 µm to 15.4 µm. The spatial footprint of the infrared channels is 1.1° in diameter, which corresponds to about 15x15 km in the nadir.

During each scan, the rotating external mirror scans the underlying Earth scene from 49° on one side of the nadir to 49° on the other side, in 90 integration periods, and provides two views of dark space (one before and one after the Earth scene), one view of an internal radiometric calibration target, and one view of an internal spectral calibration target. Thus each scan produces 94 sets of measurements (90 earth scenes and 4 calibrations). The scan is repeated every 8/3 seconds. The downlink data rate from the AIRS instrument is 1.2 Mbit/sec.

The IR focal plane is cooled to about 58 K by a Stirling/pulse tube cryocooler. The scan mirror operates at approximately 265 K due to radiative coupling to the Earth and space and to the 150 K IR spectrometer. Cooling of the IR optics and detectors is necessary to achieve the required instrument sensitivity.

**AIRS IR channel characteristics**

The properties of the 2378 AIRS instrument detectors are individually listed in self-documenting text files. Some properties of the channels change slowly with time or discontinuously whenever the instrument is warmed by a spacecraft safety shutdown or in a defrost cycle. Whenever this occurs, a recalibration exercise is performed and a new channel properties file is created. Thus a series of these files will result. The L1B PGE must use the proper one (chosen by date of properties file and date of data) for initial processing and reprocessing.

The file names contain a date, identifying the first date for which they are valid (and supersede a channel properties file containing an earlier date). As of this release, there are five such files covering the time period from 5/04/02 to the present. Text versions are provided as ancillary files to this document:

| Channel Properties Files |
|---|
| L2.chan_prop.2002.08.30.v8.1.0.txt |
| L2.chan_prop.2002.09.17.v8.1.0.txt |
| L2.chan_prop.2002.10.22.v8.1.0.txt |
| L2.chan_prop.2003.01.10.v8.1.0.txt |
| L2.chan_prop.2003.11.19.v8.1.0.txt |

## AIRS Instrument state

Instrument is in nominal science mode (instrument flag **OpMode** = ‘Operate’)
The quality of the calibration is judged to be good

## Radiometric calibration

Refer to papers:

Pagano, T.S., Aumann, H.H., Hagan, D.E., and Overoye, K., “Prelaunch and In-Flight Radiometric calibration of the Atmospheric infrared Sounder (AIRS)”, ”, *IEEE Transactions on Geosciences and Remote Sensing*, pp 265-273, 41., 2003.

Hagan, D. and P. Minnett, “AIRS radiance validation over ocean from sea surface temperature measurements”, *IEEE Transactions on Geosciences and Remote Sensing*, pp 432-441, 41., 2003.

Aumann, H. H., M.T. Chahine and D. Barron, "Sea Surface Temperature Measurements with AIRS: RTG.SST Comparison", Proc. SPIE Vol.5151, pp.252-260, San Diego August 3, 2003.

Aumann, H. H., David Gregorich and Diana Barron (2004), "Spectral Cloud-screening of AIRS data: Non Polar Ocean", Proc. SPIE 49th Annual Meeting on Optical Science and Technology 2-6 August 2004, Denver Colorado 5548-42

Aumann, H.H., David Gregorich, Steve Gaiser and Moustafa T. Chahine (2004) “Application of Atmospheric Infrared Sounder (AIRS) Data to Climate Research”
Proc. SPIE 5570 Las Palomas, Spain, September 2004

## AIRS Spectral Calibration

Refer to paper:

Gaiser, S. L., H. H. Aumann, L. L. Strow, S. E. Hannon, and M. Weiler, ”In-flight spectral calibration of the atmospheric infrared sounder (AIRS)”, *IEEE Trans. Geosci. Remote Sensing*, vol. 41, pp. 287-297, Feb. 2003

### AIRS Spatial Calibration

Refer to paper:

Gregorich, D. T. and H. H. Aumann, ”Verification of AIRS Boresight Accuracy Using Coastline Detection”, *IEEE Trans. Geosci. Remote Sensing*, vol. 41, pp. 298-302, Feb. 2003

## Visible/NIR

The Visible/Near-IR (VIS/NIR) photometer contains four spectral bands, each with nine pixels along track, with a 0.185 degree instantaneous field-of-view (FOV). It is boresighted to the IR spectrometer to allow simultaneous measurements of the visible and infrared scene. The VIS/NIR photometer uses optical filters to define four spectral bands in the 400 nm to 1000 nm region. The VIS/NIR detectors are not cooled and operate in the 293 K to 300 K ambient temperature range of the instrument housing. The spatial resolution at nadir is 2.3 km. The primary function of the AIRS VIS/NIR channels is to provide diagnostic support to the infrared retrievals: setting flags that warn of the presence of low-clouds or highly variable surface features within the infrared FOV.

### Visible/NIR Instrument state

Instrument is in nominal science mode (instrument flag **OpMode** = ‘Operate’)

### Visible/NIR Radiometric calibration and Channel Characteristics

Refer to paper:

Gautier, C., Y. Shiren, L. L. and M. D. Hofstadter, ”AIRS vis/near IR instrument”, *IEEE Trans. Geosci. Remote Sensing*, vol. 41, pp. 330-342, Feb. 2003

The Vis/NIR L1B radiances have been calibrated and validated by vicarious calibration, as described in AIRS Design File memo ADF-590-Revised dated 9/27/02. The file is available:

**VisGainCalibration.pdf**

Field data collected at the time of this writing, but not yet published, confirms the radiances are valid to the quoted accuracy: 11% for Channel #1 and 7% for Channels #2,3 and 4. This accuracy does not apply to the first few samples of

Channel #4 in each scanline. These data have anomalously low values as reported in the accompanying disclaimer file.

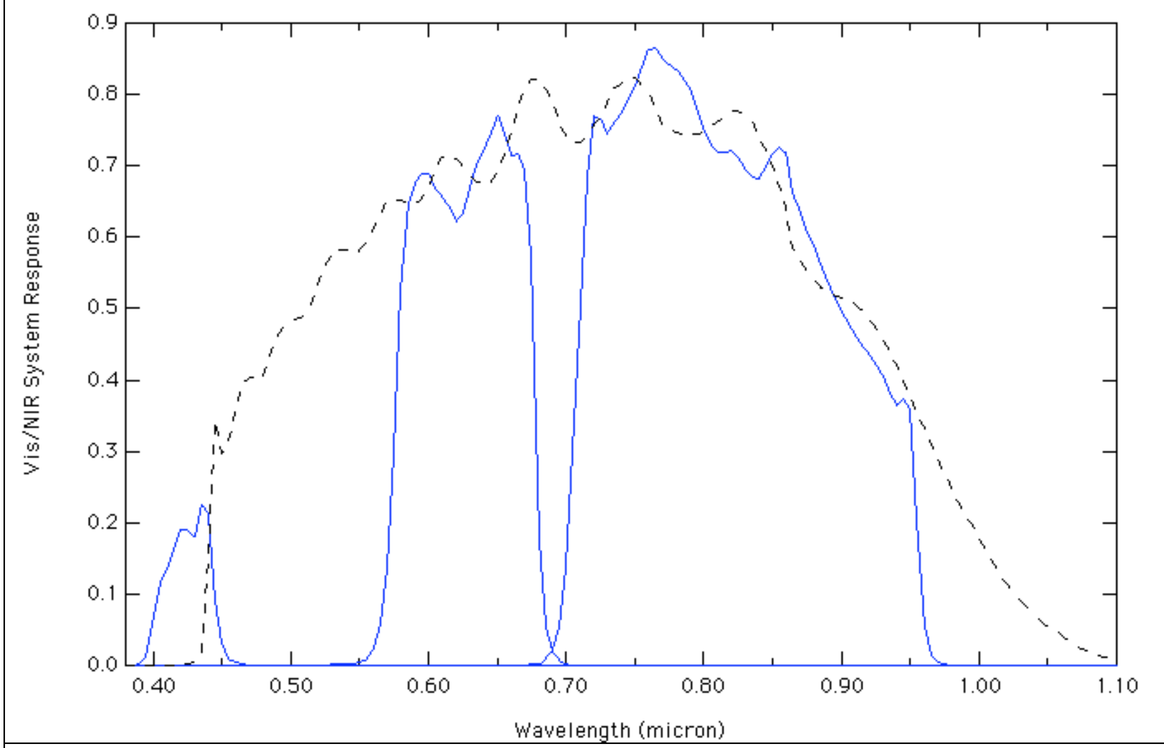


**Figure 1: The approximate spectral response of the four VIS/NIR channels. The three solid curves are, from left to right, Channels 1, 2, and 3. The dashed curve is the response of Channel 4.**

Channel 1 (0.40 to 0.44 µm) is designed to be most sensitive to aerosols. Channels 2 (0.58 to 0.68 µm) and 3 (0.71 to 0.92 µm) approximate the response of AVHRR channels 1 and 2, respectively, and are particularly useful for surface studies. (AVHRR is an imaging instrument currently carried by NOAA polar orbiting satellites.) Channel 4 has a broadband response (0.49 to 0.94 µm) for energy balance studies.

## Visible/NIR Pointing

Validation of the Vis/NIR pointing is not yet complete, but initial comparisons to other satellite data (Terra MISR and Aqua MODIS instruments) suggests it is accurate to within 0.3 degrees (corresponding to 4 km at nadir).

Note: To reduce the data volume, not every VIS/NIR pixel is geolocated. Instead, only the four “corner pixels” of the 9x8 grouping associated with each IR footprint are geolocated. (A bi-linear interpolation can be used to locate the remaining pixels.) In the data files, four-element arrays called "cornerlats" and "cornerlons" carry this information. The first array element is the upper-left pixel when viewing an image aligned with "up" being North. The second element is the upper-right pixel. The third and fourth elements refer to the lower-left and lower-right pixels, respectively.

## AMSU-A

AMSU-A is a 15-channel microwave temperature sounder implemented as two independently operated modules. Module 1 (AMSU-A1) has 12 channels in the 50-58 GHz oxygen absorption band which provide the primary temperature sounding capabilities and 1 channel at 89 GHz which provides surface and moisture information. Module 2 (AMSU-A2) has 2 channels – one at 23.8 GHz and one at 31.4 GHz which provide surface and moisture information (total precipitable water and cloud liquid water). Like AIRS, AMSU-A is a cross-track scanner. The three receiving antennas – two for AMSU-A1 and one for AMSU-A2 – are parabolic focusing reflectors that are mounted on a scan axis at a 45° tilt angle, so that radiation is reflected from a direction along the scan axis ( a 90° reflection). AMSU-A scans three times as slowly as AIRS (once per 8 seconds) and its footprints are approximately three times as large as those of AIRS (45 km at nadir). This results in three AIRS scans per AMSU-A scans and nine AIRS footprints per AMSU-A footprint.

### AMSU-A Instrument state

Instrument is in nominal science mode
Both AMSU modules are in the optimal space view position

On 11/16/2004 at 13:21:19 UT all of the AMSU-A2 temperature read outs except the warm load temperatures showed a sudden and simultaneous increase in noise. Subsequent analyses indicate that failure of a compensation capacitor in the reference voltage amplifier is the most probable cause. This will have a negligible effect on science products because RF shelf temperature enters into the calibration in a small second-order term. At the same time, however, the warm load temperature appeared to undergo a decrease of 0.15 K. Analysis continues to determine whether the warm load temperature offset continued. If so, the DN to EU conversion in the calibration algorithm will require modification.

### AMSU-A Radiometric calibration

The data have been reprocessed with the current best calibration algorithm and calibration parameters.
Calibration accuracy is estimated to be on the order of 1 K
Radiometric sensitivity is better than requirements – see AMSU-A channel characteristics table, below.

The quality of the calibration is judged to be good, but at present there are substantial scan biases. Modeling of the sidelobe pickup is under way to correct these scan biases.
L1B data contain fields named "**antenna_temp**" and "**brightness_temp**". Both are well calibrated and without sidelobe correction in this release. The **brightness_temp** data field will include sidelobe correction in a future release. In this release the two fields are identical. Comparisons of AMSU antenna temperatures with non-polar calculated brightness temperatures exhibit differences of up to 3 K, which for the tropospheric channels are consistent in sign and magnitude with the hypothesis that the biases are due to sidelobe effects.
Channel 7 has additional correlated noise, and should be avoided in applications that use single measurements, such as comparisons with collocated soundings. It may be used in applications in which some averaging is done (i.e. gridding/binning or regional averages)
Channel 6 exhibits additional correlated noise; similar to channel 7 but much smaller
Channel 9 exhibits occasional popping, i.e. the calibration counts suddenly drop and then quickly recover. This typically occurs no more than once per orbit.
Channel 14 may have correlated noise, but it is minor

## <u>AMSU-A Preliminary Pointing Analysis using Coastlines</u>

Valid for channels 1, 2, 3, 15 (window channels)
Pitch error < 10% of FOV (< 4 km at nadir)
Roll Error estimated to be less than 20% of FOV
Yaw error estimated to be less than 30% of FOV at swath edge

Relevant analysis
See Accompanying Document: **MW_L1B_Assessment.pdf**
which is based upon a status report given to the AIRS Science Team in September 2002 and has been updated as of March 10, 2003.

**AMSU-A channel characteristics**

| Ch # | Module | Center freq [MHz] | Stability [MHz] | Bandwidth [MHz] | On-Orbit NEdT[K] | T/V NEdT[K] | Pol |
|---|---|---|---|---|---|---|---|
| 1 | A2 | 23800 | ±10 | 1x270 | 0.17 | 0.17 | V |
| 2 | A2 | 31400 | ±10 | 1x180 | 0.19 | 0.25 | V |
| 3 | A1 | 50300 | ±10 | 1x160 | 0.21 | 0.25 | V |
| 4 | A1 | 52800 | ±5 | 1x380 | 0.12 | 0.14 | V |
| 5 | A1 | 53596±115 | ±5 | 2x170 | 0.16 | 0.19 | H |
| 6 | A1 | 54400 | ±5 | 1x380 | 0.21 | 0.17 | H |
| 7 | A1 | 54940 | ±5 | 1x380 | 0.21 | 0.14 | V |
| 8 | A1 | 55500 | ±10 | 1x310 | 0.14 | 0.16 | H |
| 9 | A1 | [$f_0$]=57290.344 | ±0.5 | 1x310 | 0.14 | 0.16 | H |
| 10 | A1 | $f_0$±217 | ±0.5 | 2x77 | 0.19 | 0.22 | H |
| 11 | A1 | $f_0$±322.4±48 | ±1.2 | 4x35 | 0.22 | 0.24 | H |
| 12 | A1 | $f_0$±322.4±22 | ±1.2 | 4x16 | 0.31 | 0.36 | H |
| 13 | A1 | $f_0$±322.4±10 | ±0.5 | 4x8 | 0.43 | 0.50 | H |
| 14 | A1 | $f_0$±322.4±4.5 | ±0.5 | 4x3 | 0.71 | 0.81 | H |
| 15 | A1 | 89000 | ±130 | 1x2000 | 0.10 | 0.12 | V |

## HSB

The Humidity Sounder for Brazil (HSB) is a 4-channel microwave moisture sounder implemented as a single module. Three channels are located near 183 GHz, while the fourth is a window channel at 150 GHz. Physically HSB is identical to AMSU-B, which is operated by NOAA on its most recent POES satellites, but HSB lacks the fifth channel (89 GHz) of AMSU-B. Like AIRS, HSB is a cross-track scanner, and it has only one parabolic scan mirror. Its scan speed as well as its footprints is similar to AIRS (three scans per 8 seconds and about 15 km at nadir, respectively). There is therefore one HSB footprint per AIRS footprint.

**HSB ceased operation on February 5, 2003 due to a failure in the mirror scan motor electronics.**

**HSB Instrument state**

Instrument failed Feb 5, 2003. An anomaly investigation team has concluded that the most likely failure cause was a bad connection or solder joint in the motor drive electronics commutation circuit. The symptoms seen on orbit were replicated on an engineering model.

## Radiometric calibration

The data have been reprocessed with the current best calibration algorithm and calibration parameters.
Calibration accuracy is estimated to be on the order of 1 K
Radiometric sensitivity is better than requirements – see HSB channel characteristics table, below.
The quality of the calibration is judged to be good, but at present there are substantial scan biases. Modeling of the sidelobe pickup is under way to correct these scan biases.
L1B data contain fields named "**antenna_temp**" and "**brightness_temp**". Both are well calibrated and without sidelobe correction in this release. The **brightness_temp** data field will include sidelobe correction in a future release. In this release the two fields are identical. The sidelobe corrections for HSB in a future release are small, so differentiation between the two fields will be minor. **.**
Validation using radiosondes in non-polar regions shows biases well under 1 K for all channels and latitude is not expected to make a difference to the validity of the calibration.

## HSB Preliminary Pointing Analysis using Coastlines

Valid for channel 2 (window channel)
Pitch error < 10% of FOV (< 1.5 km at nadir)
Roll Error estimated to be less than 20% of FOV
Yaw error estimated to be less than 30% of FOV at swath edge

Relevant analysis
See Accompanying Document: **MW_L1B_Assessment.pdf**
which is based upon a status report given to the AIRS Science Team in September 2002 and has been updated as of March 10, 2003.

Refer to paper:

Lambrigtsen, B. H., and R. V. Calheiros, "The humidity sounder for Brazil--an international partnership", *IEEE Trans. Geosci. and Remote Sensing, 41*, 2, pp 352-361, 2003.

## HSB channel characteristics

| Ch # | Center freq [MHz] | Stability [MHz] | Bandwidth [MHz] | On-Orbit NEdT[K] | T/V NEdT[K] | Pol |
|---|---|---|---|---|---|---|
| 1 | AMSU-B channel 1 was not implemented for HSB | | | | | |
| 2 | 150000 | ±100 | 2x1000 | 0.58 | 0.68 | V |
| 3 | 183310±1000 | ±50 | 2x500 | 0.55 | 0.57 | V |
| 4 | 183310±3000 | ±70 | 2x1000 | 0.35 | 0.39 | V |
| 5 | 183310±7000 | ±70 | 2x2000 | 0.28 | 0.30 | V |

## Relation of Fields of View of AIRS/AMSU/HSB

A granule of data contains 45 scansets, corresponding to 45 cross-track scans of the AMSU-A mirror. The AMSU-A radiance data sampled in a scanset are combined to create integrated radiances for 30 contiguous AMSU-A FOVs. An integration encompasses the time required for the mirror to sweep through an AMSU-A instantaneous FOV. Figure 2 illustrates the retrieval FOV pattern over Southern California that make up Granule 209 of AIRS/AMSU/HSB products on September 6, 2002.

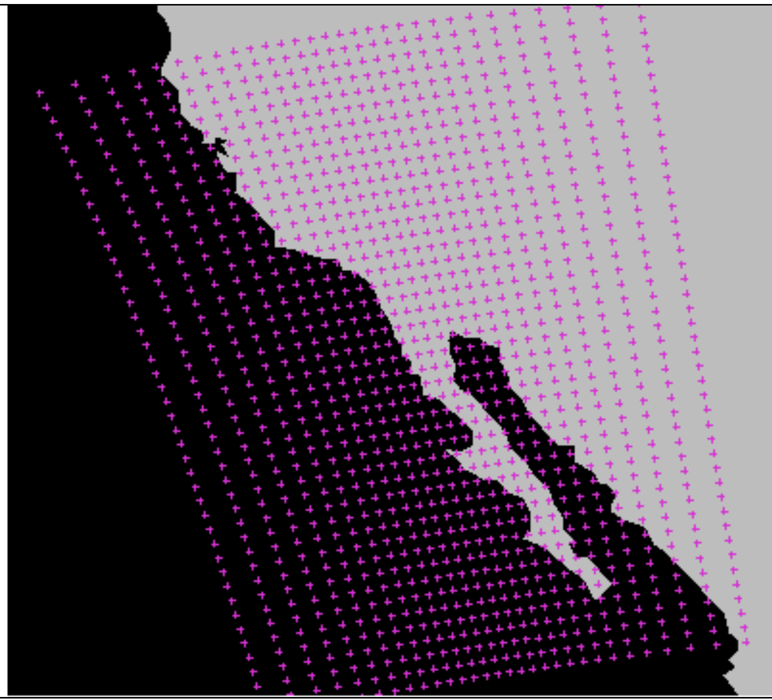

**Figure 2: AIRS/AMSU/HSB Footprint Pattern Sept 6, 2002; Granule 209**

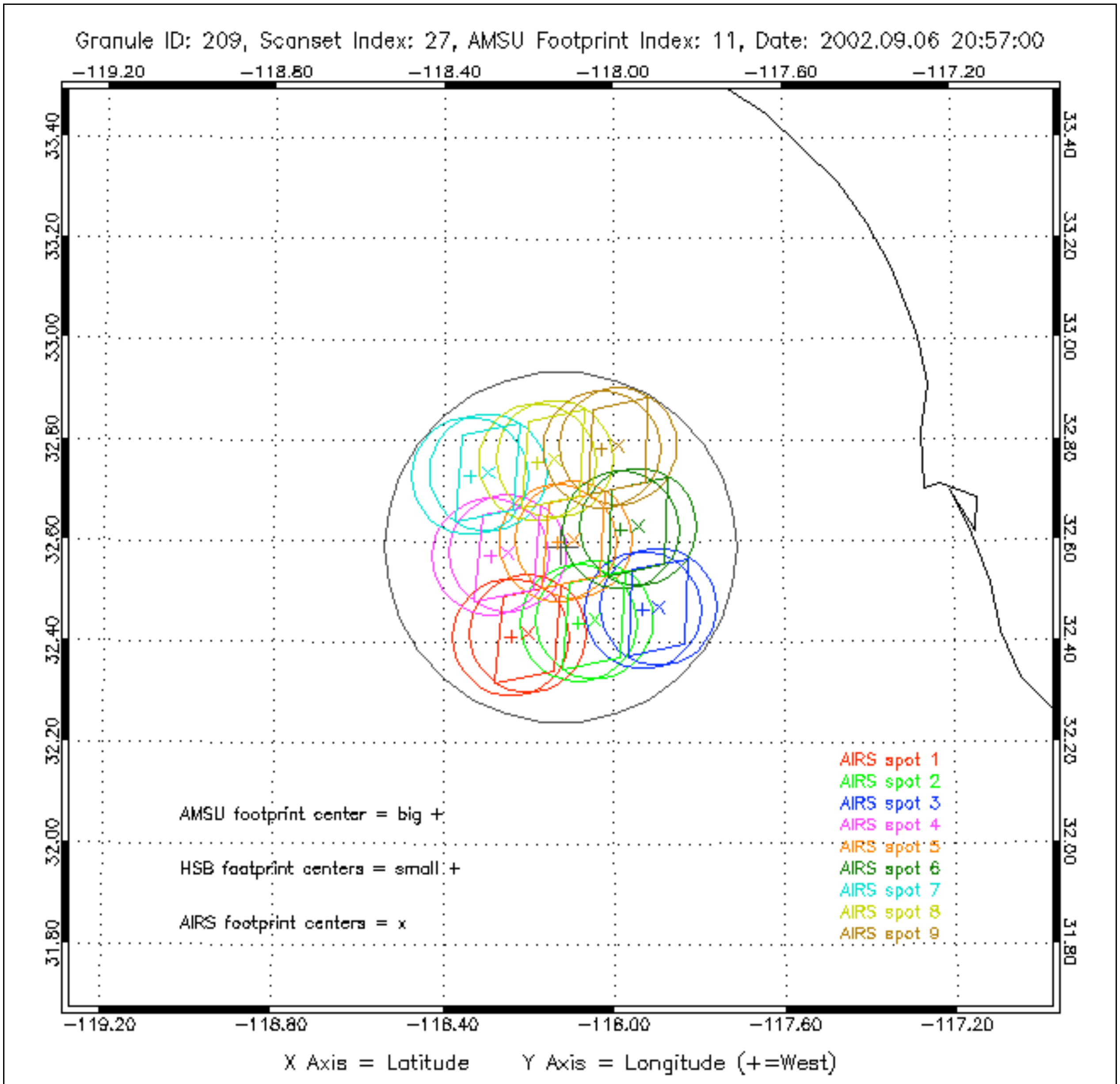


**Figure 3: AIRS/AMSU/HSB Footprint Pattern**
**Sept 6, 2002; Granule 209; Scanset 27; Footprint 11**
**central (lat,lon) = (32.6°, -118.1°)**

An AMSU-A FOV encompasses 9 AIRS FOVs (arranged in a 3x3 matrix) and 9 HSB FOVs (arranged in a 3x3 matrix). Each AIRS footprint encompasses 72 Vis/NIR pixels (arranged in a 9x8 rectangular array). This arrangement is illustrated in Figure 2, which was produced from the geolocation information contained within Granule 209 of data taken September 6, 2002, just off the coast of Southern California. The association shown comprises those data which are combined into a retrieval field-of-view located in the 11 th AMSU-A FOV of the 27th AMSU-A scanset. The large circle represents the 3.3 deg instantaneous FOV of an AMSU-A observation. The smaller colored circles represent the 1.1

deg instantaneous FOVs of the associated arrays of AIRS and HSB observations. The colored rectangles represent the areas covered by the associated arrays of VIS/NIR pixels.

Since granule 209 is an ascending (daytime) granule, the spacecraft track tends toward the northwest. The scan direction as seen by an observer sitting on the spacecraft and facing the direction of motion is left to right. Thus the scan direction on the Earth for this granule is also left to right in this figure.

Within each scanset are three scanlines, corresponding to 3 cross-track scans of the AIRS and HSB mirrors. The AIRS and HSB radiance data sampled in each scanline are combined to create integrated radiances for 90 AIRS and 90 HSB footprints.

The VIS/NIR instrument has an array of 9 detectors arranged along the spacecraft track direction that look at the AIRS mirror. Sampling and integration are arranged so that there are 8 cross-track samples of each VIS/NIR detector as the mirror sweeps through one AIRS instantaneous FOV.

# AIRS Science Processing System

## *System Overview*

The AIRS Science Processing System (SPS) is a collection of programs, or Product Generation Executives (PGEs), used to process AIRS Science Data. These PGEs process raw, low level AIRS Infrared (AIRS), AIRS Visible (VIS), AMSU, and HSB instrument data to obtain temperature and humidity profiles.

AIRS PGEs can be grouped into four distinct processing phases for processing: Level 1A, Level 1B, Level 2 and Level 3. Each consecutive processing phase yields a higher-level data product. Levels 1A and 1B result in calibrated, geolocated radiance products. Level 2 processing derives temperature and humidity profiles, and cloud and surface properties. Level 3 produces gridded ascending and descending products from the Level 2 products averaged daily, over 8 day periods and for each month. In addition to the standard processing PGEs, there are additional Browse PGEs that are run to produce an aggregate qualitative summary for each standard product and a radiosonde matchup PGE which collects and associates all AIRS products derived within 100 km and 3 hr of ADP operational upper air radiosonde launches reported in the National Centers for Environmental Prediction (NCEP) quality controlled final observation data files (PREPQC). Figure 4 is a diagram illustrating the processing flow of the AIRS Science Processing System through Level 2.

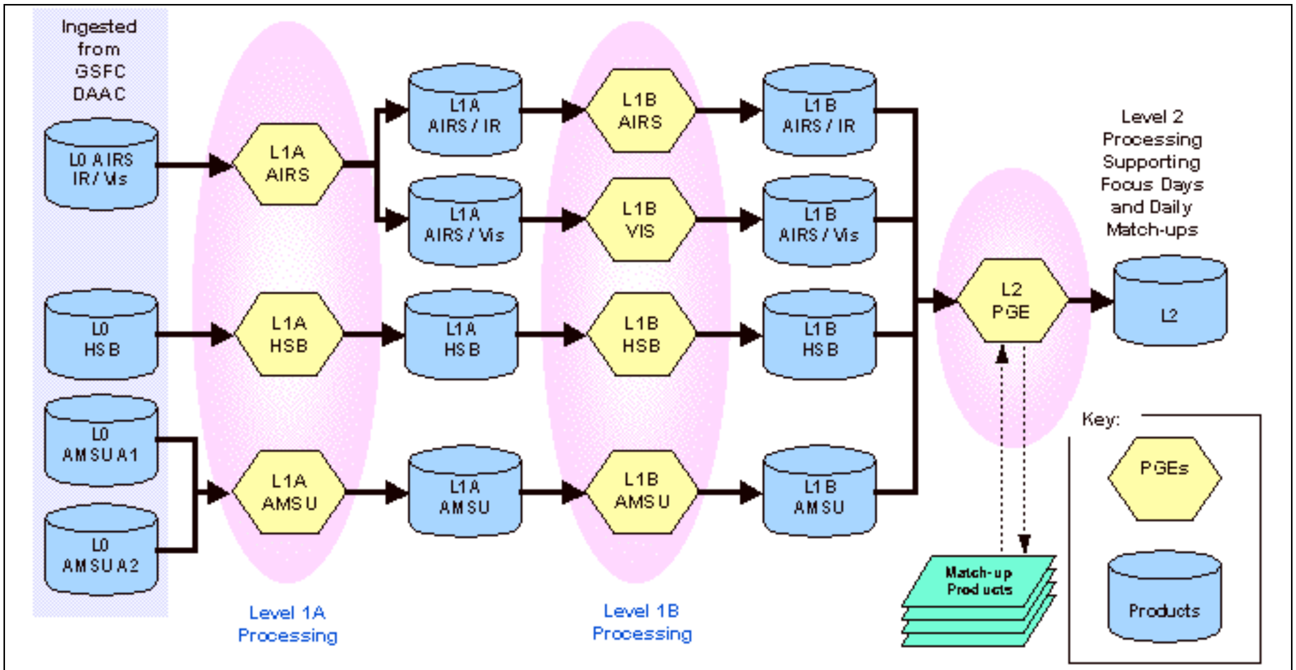


**Figure 4: AIRS Science Processing System Processing Flow through L2**

## *Data Processing –Version 4.0*

The V4.0 Release Science Processing Software (SPS) provided to the Goddard Space Flight Center (GSFC) Distributed Active Archive Center (DAAC) for L2 Product Generation is version 4.0.9.0 and represents the best refinement of all Level 1A, Level 1B Level 2 and Level 3 PGEs as of February 1, 2005. It contains working versions of all Level 1A, Level 1B, Level 2 and Level 3 software modules. Specific features and characteristics of version 3.0.9.0 are described in other sections of this documentation. See **V4_Release_Proc_FileDesc.pdf** for a complete description of the data product files and the ancillary static and dynamic inputs to the various PGEs.

The enhancements to Level 1A and Level 1B reflect lessons learned from analysis of post-launch data. The Level 2 and Level 3 software is still under development, and JPL plans to continue to upgrade these PGEs and will deliver updated code modules to the GSFC DAAC to support public release of their products in early 2006.

## *Level-1A Processing*

AIRS data processing begins with receipt of Level 0 data from the Earth Observing System (EOS) Data and Operations System (EDOS). When Level 0 data are received, Level 1A PGEs are scheduled. The Level 1A PGEs perform basic house keeping tasks such as ensuring that all the Level 0 data are present and ordering the data into time of observation synchronization. Once the Level 0 data are organized, algorithms perform geolocation refinement and conversion of raw Data Numbers to Engineering Units (DN to EU). Finally, the level 1A data are collected into granules of data (six minutes of instrument data) and are forwarded to Level 1B PGEs for further processing.

## *Level-1B Processing*

Level 1B PGEs receive 240 granules of AIRS (AIRS IR, AIRS VIS, AMSU and HSB) Level 1A EU data and produce calibrated, geolocated radiance products. Calibration data and calibration control parameters are analyzed to develop processing specifications for Level 1B processing. Then, the Level 1A data are processed, yielding our Level 1B standard products. Each type of AIRS Level 1A data is processed by a specialized Level 1B PGE. Each Level 1B PGE generates 240 granules of Level 1B standard products.

Level 1B PGEs produce 240 granules of 4 Level 1B standard products and 2 quality assessment (QA) subset products. Each granule is composed of 45 scansets. The Earth Science Data Type (ESDT) short names and normal granule sizes are:

| Data Set | Short Name | Granule Size |
|---|---|---|
| L1B AMSU-A brightness temperatures | AIRABRAD | 0.5 MB |
| L1B HSB brightness temperatures | AIRHBRAD | 1.7 MB |
| L1B AIRS radiances | AIRIBRAD | 56 MB |
| L1B VIS radiances | AIRVBRAD | 21 MB |
| L1B AIRS QA | AIRIBQAP | 5.6 MB |
| L1B VIS QA | AIRVBQAP | 1.1 MB |

Figure 5 on the following page shows the combined AMSU and HSB spectra for the example AMSU FOV first introduced in Figure 2. Channel number is shown along the vertical axes (AMSU to the left and HSB to the right), and the horizontal axis represents brightness temperature. The AMSU temperature sounding channels (3-14) are connected with line segments and that plot can be viewed as a rudimentary representation of the temperature profile. The lowest channel is affected by the surface, however, which depresses the brightness temperature relative to the atmospheric temperature for this oceanic FOV. The nominal weighting functions for the tropospheric channels peak as follows: surface (#3), 1000 mb (#4), 750 mb (#4), 400 mb (#6), 250 mb (#7), 150 mb (#8)

AMSU channels 1, 2 and 15 are plotted separately as bars, since they are window channels that are primarily influenced by the surface brightness (i.e. the product of surface temperature and emissivity). Ocean emissivity is very low for channels 1 and 2, which causes very low brightness temperatures, even though the SST is relatively high. Channel 1 is warmer than channel 2 because it is affected by water vapor and clouds, which elevates the brightness temperature over the "cold" ocean background. Channel 15 is warmer still, due to a higher emissivity as well as higher sensitivity to both water vapor and clouds.

HSB has 4 channels and 9 FOVs within the single AMSU FOV, resulting in the 9 line plots shown to the right. The vertical order of the channels reflect the order of the peak in the weighting function rather than the serial channel number. These channels essentially reflect the atmospheric temperature near the peaks of the water vapor/liquid weighting functions. The lowest channel (#2) peaks near the surface (but is slightly "cooler" than the surface due to the emissivity). The highest channel (#3), which is too opaque to have much influence from the surface, has a brightness temperature somewhere between AMSU channels 4 and 5, which suggests it peaks at perhaps 850 mb. The spread between the 9 plots suggests there is some (but not much) variability in water vapor and liquid water.

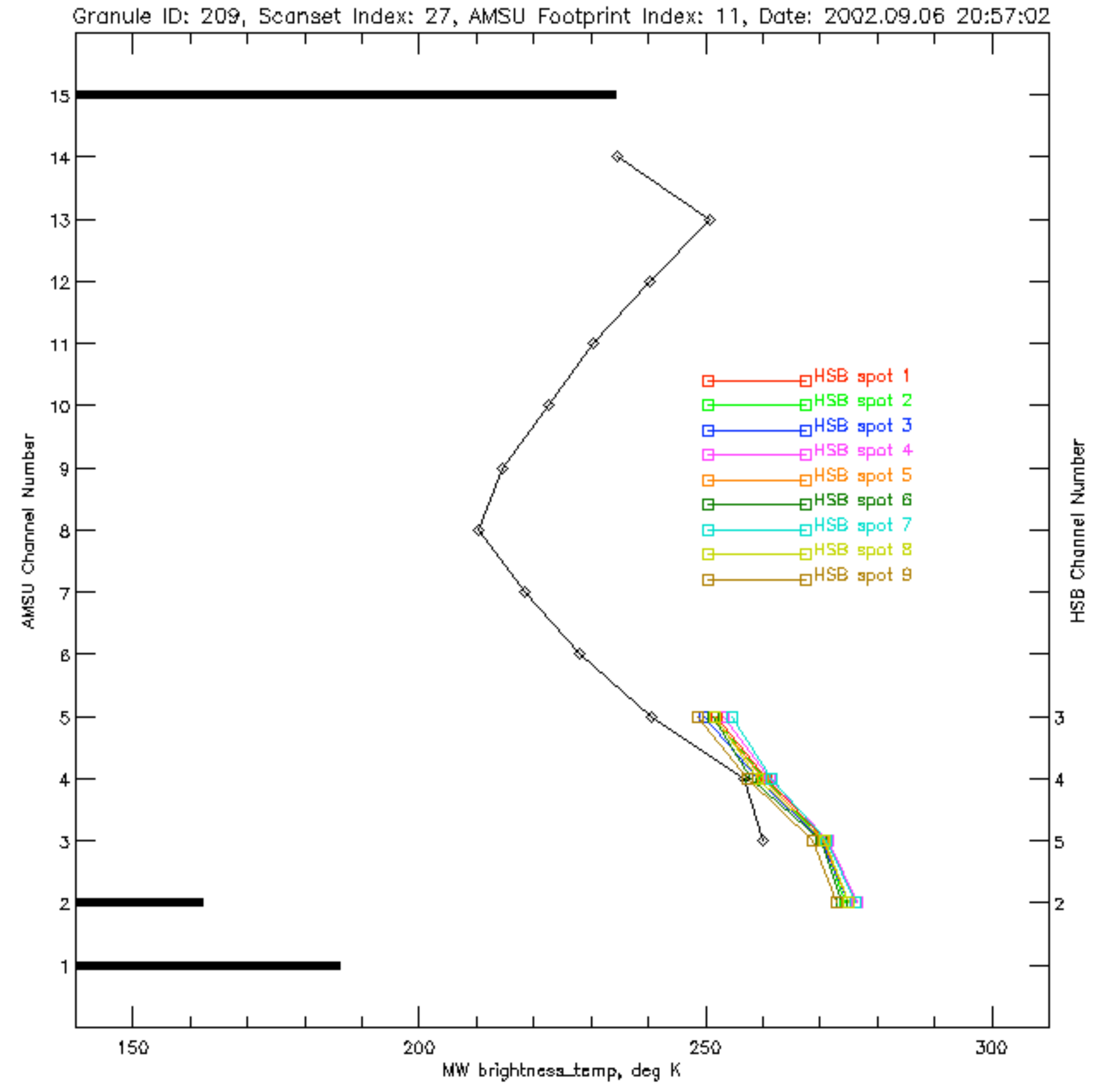


**Figure 5: Level 1B Microwave Radiances (AMSU-A and HSB)**
**Sept 6, 2002; Granule 209; Scanset 27; Footprint 11**

Figure 6 shows the infrared Level 1B radiance spectra (AIRS) from the example FOV, which contains 9 AIRS spots. These data are contained in the L1B AIRS Radiance Product.

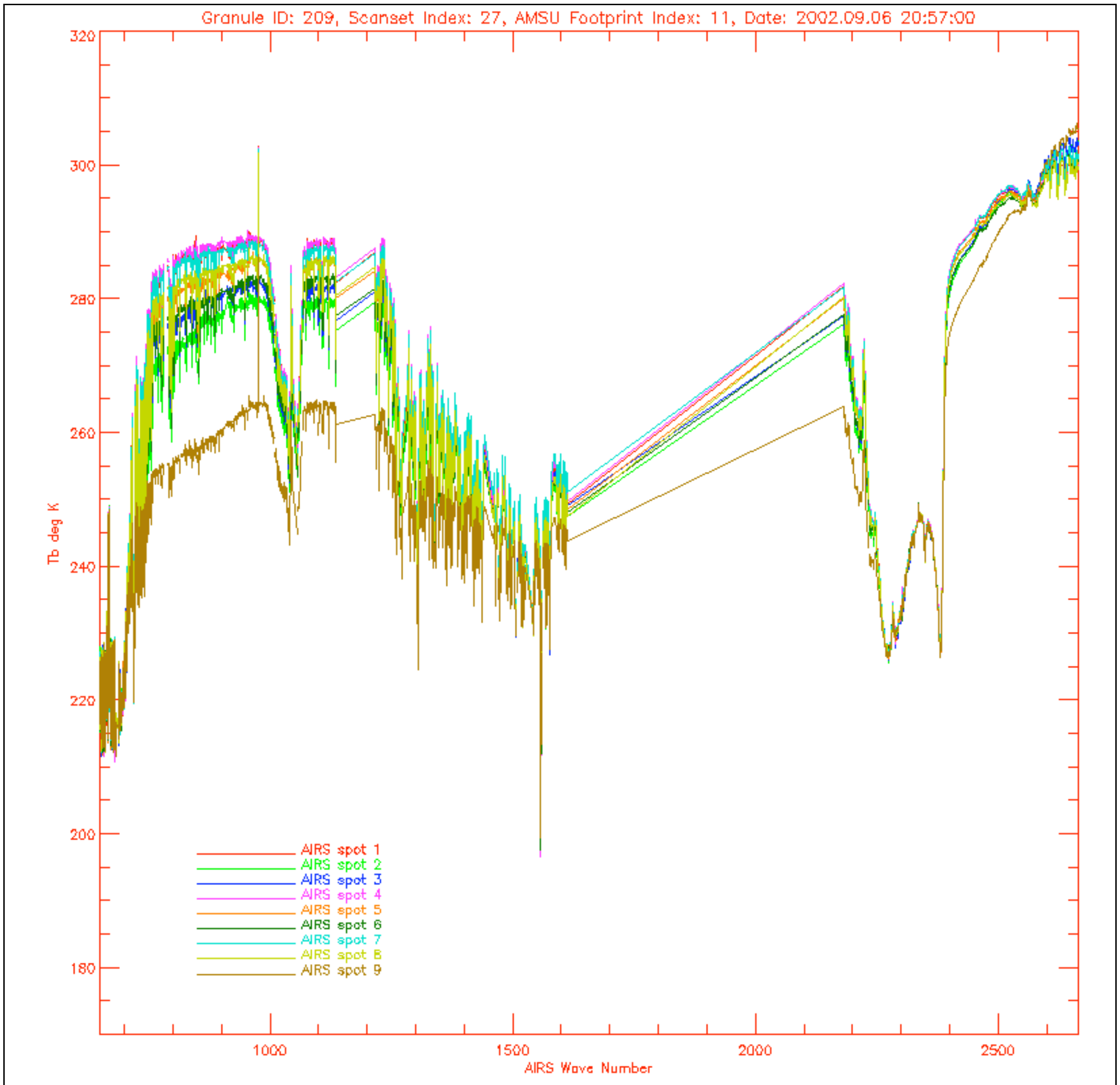


**Figure 6: Level 1B Infrared Radiance Spectra (AIRS) Sept 6, 2002; Granule 209; Scanset 27; Footprint 11**

The brightness temperature in the 900 $cm^{-1}$ region varies from around 260K to just under 290K. The AMSU footprint is over ocean and relatively uniform with the exception of cloud properties. Thus the variability of brightness temperature is mostly due to the effect of clouds. Cloud-clearing in the Level 2 retrieval estimates the clear column radiance from the cloud radiances by extrapolation. Note the slope of the coldest spectrum (color-coded brown) in the 900 $cm^{-1}$ region. Since cloud tops tend to be colder than the surface, this is most likely the cloudiest of the nine AIRS footprints. The slope is one of the signatures of cirrus clouds. This spectrum appears to reflect more solar radiance than other AIRS spectra (i.e., higher brightness temperature in 2600 $cm^{-1}$ region).

The AIRS Calibration Team documents the required inputs and outputs of the AIRS IR and VIS/NIR Level 1B processing software, algorithms for converting AIRS IR digital values to calibrated radiances, and QA algorithms and indicators in "Atmospheric Infrared Sounder (AIRS) Level 1B Visible, Infrared and Telemetry Algorithms and Quality Assessment (QA) Processing Requirements." Version 2.2 of this document, dated 2/14/03, is

**L1B_req_v2.3.pdf**

The interested user will find additional information on QA indicators for AIRS IR and VIS/NIR L1B products in this document.

Experience with on-orbit AIRS data prompted the AIRS Calibration Team to alter some AIRS L1B algorithms (e.g. AutomaticQAFlag, DC Restore, pop detection, Moon-in-view, offset, noise estimation and gain). The brief AIRS Design File Memo describing these changes, dated 6/24/03, is

**L1bqa_changes.pdf**

A report of the status V4.0 calibration is provided in the document:

**V4.0_Calibration_Status.pdf**

AIRS Design File Memo (ADF-579) dated 6/12/02 provides the initial assessment of the on-orbit performance of the VIS/NIR system:

**VisInitialCheckout.pdf**

Another AIRS Design File Memo (ADF-590-REVISED) dated 9/27/02 provides the results of the first accurate determination of instrument gains of the VIS/NIR detectors on-orbit via vicarious calibration in conjunction with the MISR-Terra Calibration Team operations at Railroad Valley Playa, Nevada.

**VisGainCalibration.pdf**

The visible/near infrared data provide diagnostic support to the infrared retrievals as well as several research products. The field of radiances from the four channels can be combined to produce a low-resolution false color image of a granule. On the following page, Figure 7 is an example. It shows a false color image of the entire granule from which the data of Figures 4 and 5 were taken.

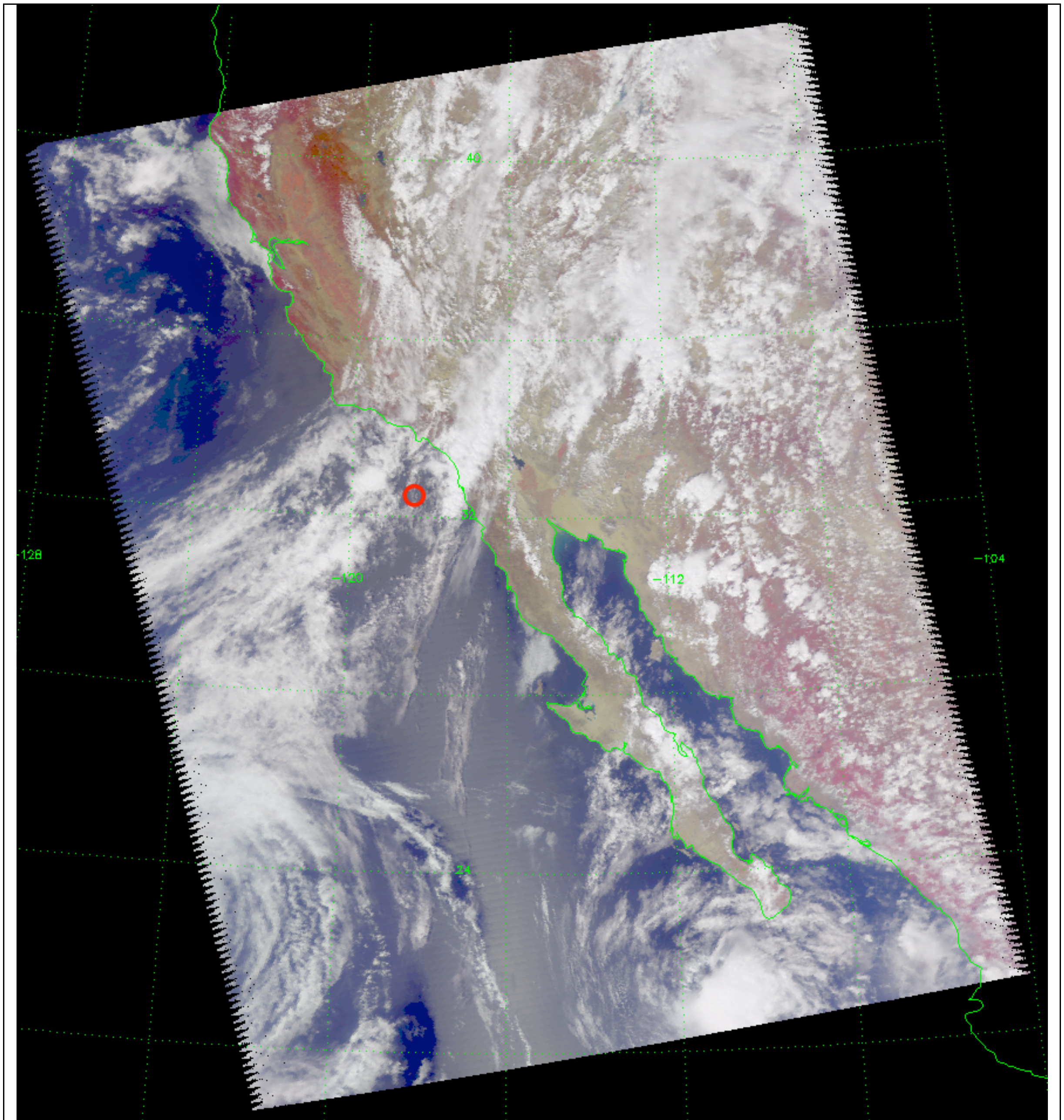


**Figure 7: false color image of Sept 6, 2002 Granule 209 constructed from Vis/NIR radiances red circle outlines example FOV; interior is approximate size of FOV**

## *Level-2 Processing*

The single Level 2 PGE reads corresponding Level 1B data granules from all instruments (AIRS IR, AIRS VIS, AMSU and HSB), the surface pressure from the NCEP forecasts and a digital elevation map. Figure 8 on the nex page is a schematic of the Level 2 algorithm flow. Depending upon the results of tests applied in the main algorithm chain (the central chain in the diagram), the Level 2 product may be one of several possibilities reported from the "Final Retrieval" stage or the output of the "MW-Only Retrieval" stage Please refer to the L2 Quality Flag Quick Start Documentation.

**V4.0_L2_QualFlag_QuickStart.pdf**

Level 2 produces 240 granules of each of the following AIRS products:

| Data Set | Short Name | Granule Size |
|---|---|---|
| L2 Cloud-cleared radiances | AIRI2CCF | 10 MB |
| L2 Standard Product | AIRX2RET | 5.4 MB |
| L2 Support Product | AIRX2SUP | 20 MB |

as well as daily global browse maps of selected products which are a selection aid for ordering data from the GSFC DAAC. Each granule contains the data fields from 1350 retrievals laid out in an array of dimension 30x45, corresponding to the 30 AMSU footprints (cross-track) in each of 45 scansets (along-track).

**IMPORTANT WARNING:**

Please note that the clear FOV detection algorithms are currently under development. There are several different clear detection algorithms being refined. They employ different algorithms depending upon their spatial resolution and spectral regime.

These clear flags are not yet incorporated into the algorithms contained in the Level 2 Processing stage. **The user is advised to ignore them**, for they and the discriminants that control them are still under development. They are described in the referenced document only because the user will encounter them in the products and may be tempted to use them to filter data. The user must not attempt to use these clear flags or their discriminants.

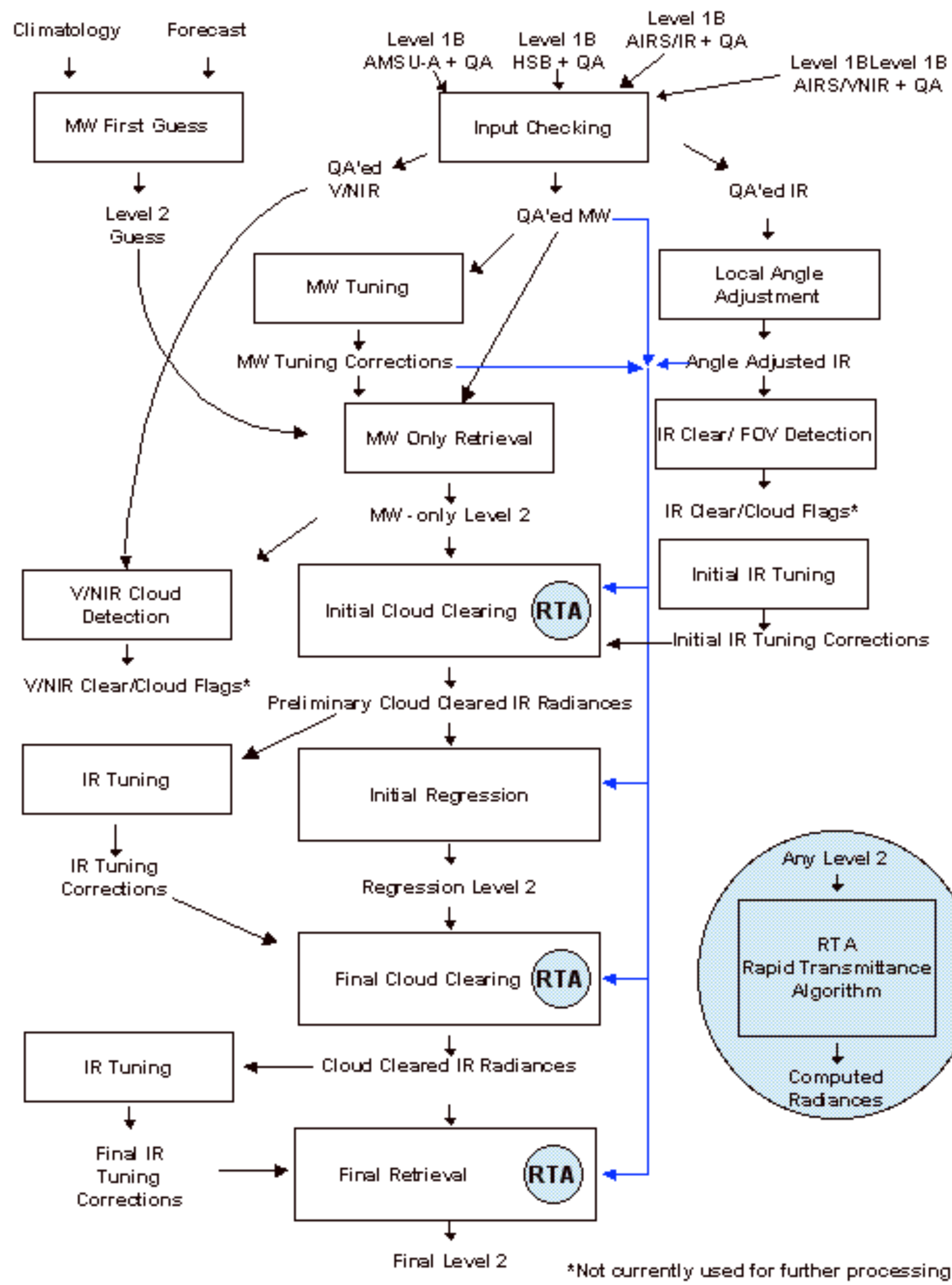


**Figure 8: AIRS Level 2 Algorithm Flow**

## *Level-3 Processing*

Level 3 products are statistical summaries of geophysical parameters that have been spatially and temporally re-sampled from lower level data products (e.g., Level 2 data). Due to re-sampling and selecting a reduced set of reporting parameters, Level 3 datasets are substantially smaller than the lower level source products from which they are derived. Thus, Level 3 products can be used without a great deal of overhead in terms of data handling.

AIRS Level 3 products differ from Browse products in that Level 3 products are a direct representation of the lower level datasets, the underlying geophysical values are retained in Level 3 whereas AIRS Browse products are pixilated representations of associated Level 2 and Level 1B data sources. In addition, counts and standard deviations are carried forth in the AIRS Level 3 products as well as the mean value per grid cell.

The daily Level 3 PGE reads Level 2 standard product data granules and a land/sea mask ancillary file. The input Level 2 data are filtered according to bit values in **RetQAFlag**, and per-parameter quality indicators, **Qual_***. For a description of these indicators, please refer to the L2 Quality Flag Quick Start Documentation and the Level 3 QuickStart Documentation:

**V4.0_L2_QualFlag_QuickStart.pdf**

**V4.0_L3_QuickStart.pdf**

Level 3 files contain geophysical parameters that have been averaged and binned into 1°x1° grid cells. Grid maps correspond to -180.0° to +180.0° longitude and -90.0° to +90.0° latitude. For each grid map of 4-byte floating-point mean values there is a corresponding 4-byte floating-point map of standard deviation and a 2-byte integer grid map of counts. The counts map provides the user with the number of points per bin that were included in the mean and can be used to generate multi-day maps from the daily gridded products.

AIRS Level 3 data products consist of three "types" of product, daily, 8-day (one-half of the Aqua orbit repeat cycle), and monthly (calendar). Each of the three Level 3 data products is separated into ascending and descending portion of the orbit, where “ascending or descending” refers to the direction of the sub-satellite point in the satellite track at the equatorial crossing. The ascending direction of movement is from Southern Hemisphere to Northern Hemisphere; the descending direction of movement is from Northern Hemisphere to Southern Hemisphere. Outside of the polar zones, these correspond respectively to daytime and nighttime. Spatial resolution for all standard Level 3 products is 1°x1° where each grid cell is bounded by latitude and longitude lines. Figure 9 is a high level flow diagram of the AIRS standard Level 3 processing, showing the production of the daily and multi-day products.

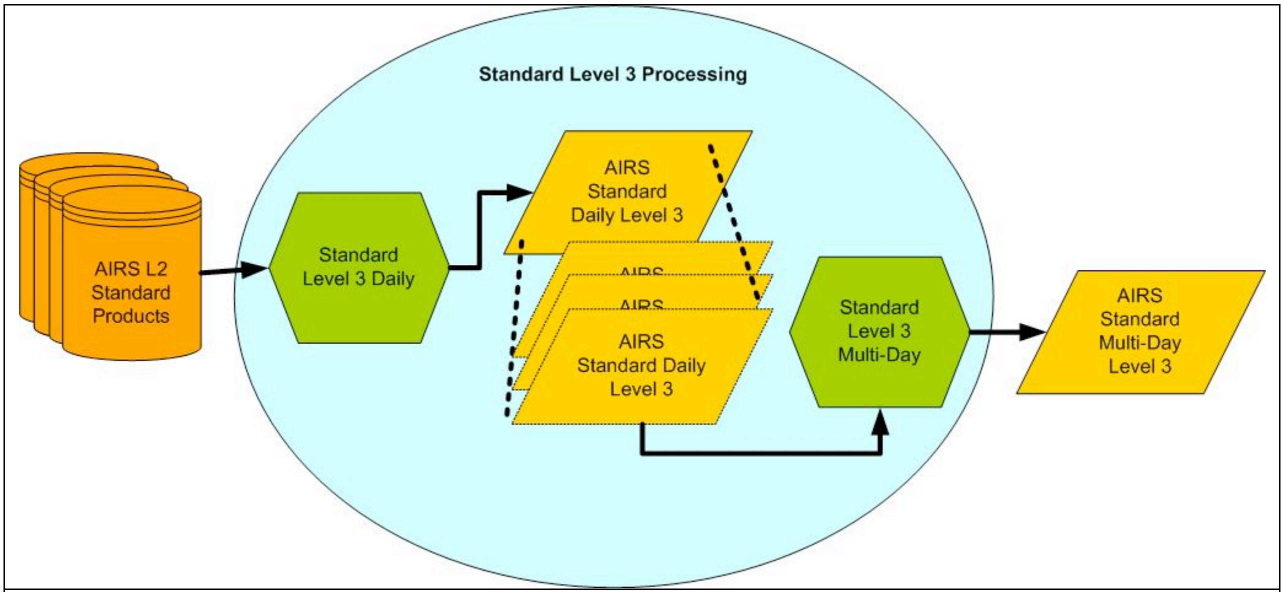


**Figure 9: High Level Flow Diagram of AIRS Standard Level 3 Processing**

The daily and multi-day Level-3 PGEs produce the following AIRS products:

| **Data Set** | **Short Name** | **Granule Size** |
|---|---|---|
| L3 standard daily product | airx3std | 33 MB |
| L3 8-day standard product | airx3st8 | 43 MB |
| L3 monthly standard product | airx3stm | 45 MB |

The daily Level 3 products will have gores between the satellite paths where there is no coverage for that day. The 8-day Level 3 products may have missing data due to data dropouts. Monthly Level 3 products will likely contain complete global coverage without gores and with little or no missing data.

Unlike the AIRS browse product that starts at day-begin (granule 1) and stops at day-end (granule 240), the AIRS Level 3 Daily Product is time-continuous from east to west and encompasses all ascending or descending orbits in 24-hour temporal period. AIRS Level 3 data begin just West of the dateline and end just East of the dateline. This is done to prevent data points that are 24 hours apart from being averaged within the same grid cell.

The Level 3 data files are rounded to a precision that is dependent upon the retrieved quantity and compressed using the HDF-EOS compression technique deflate.

The table below lists the precision for each field in the Level 3 products. All numbers are for daily products. Multi-day and monthly will have 3 additional bits (1 additional digit) for all fields except standard deviations.

| Field Name | Bits | Digits | Low value | High value |
|---|---|---|---|---|
| TotCldLiqH2O | 11 | 3.3 | 3 +/- .001 x E-5 | 10 +/- 0.004 |
| TotH2OVap | 11 | 3.3 | .05 +/- .000015 | 200 +/- 0.06 |
| TotO3 | 8 | 2.4 | 80 +/- .25 | 1300 +/- 4 |
| SurfAirTemp | 13 | 3.9 | 200 +/- .015 | 350 +/- 0.03 |
| SurfSkinTemp | 13 | 3.9 | 200 +/- .015 | 350 +/- 0.03 |
| SurfPres | 11 | 3.3 | 500 +/- .13 | 1000 +/- 0.25 |
| OLR | 11 | 3.3 | 200 +/- .06 | 300 +/- 0.13 |
| ClrOLR | 11 | 3.3 | 200 +/- .06 | 300 +/- 0.13 |
| EmisIR | 8 | 2.4 | 0.8 +/- .002 | 1 +/- 0.003 |
| GPHeight | * | 0-5 | 100 +/- 0.5 | 65000 +/- 0.5 |
| CloudFrc | 8 | 2.4 | .01 +/- .00003 | 1 +/- 0.002 |
| CloudTopPress | 8 | 2.4 | 100 +/- .25 | 1000 +/- 2 |
| RelHumid | 8 | 2.4 | 1 +/- .004 | 100 +/- 0.25 |
| H2OVapMMR | 8 | 2.4 | 5 +/- .012 x E-5 | 50 +/- 0.13 |
| Temperature | 13 | 3.9 | 200 +/- .015 | 350 +/- 0.03 |
| CloudFrcVis | 8 | 2.4 | .01 +/- .00003 | 1 +/- .003 |
| TotH2OVap_MW | 11 | 3.3 | .05 +/- .000015 | 200 +/- 0.06 |
| EmisMW_MW | 8 | 2.4 | .3 +/- .001 | 0.9 +/- .002 |
| GPHeight_MW | * | 0-5 | 100 +/- 1.0 | 65000 +/- 1.0 |
| Temperature_MW | 12 | 3.6 | 200 +/- .03 | 350 +/- .06 |
| Any standard deviation | 6 | 1.8 | 1 +/- 0.03 | 1000 +/- 16 |

(*) GP_Height uses a different scheme. It is scaled to the nearest meter for all ranges. GP_Height_MW is to the nearest 2 meters.

The AIRS Daily Level 3 processing flow is given in Figure 10.

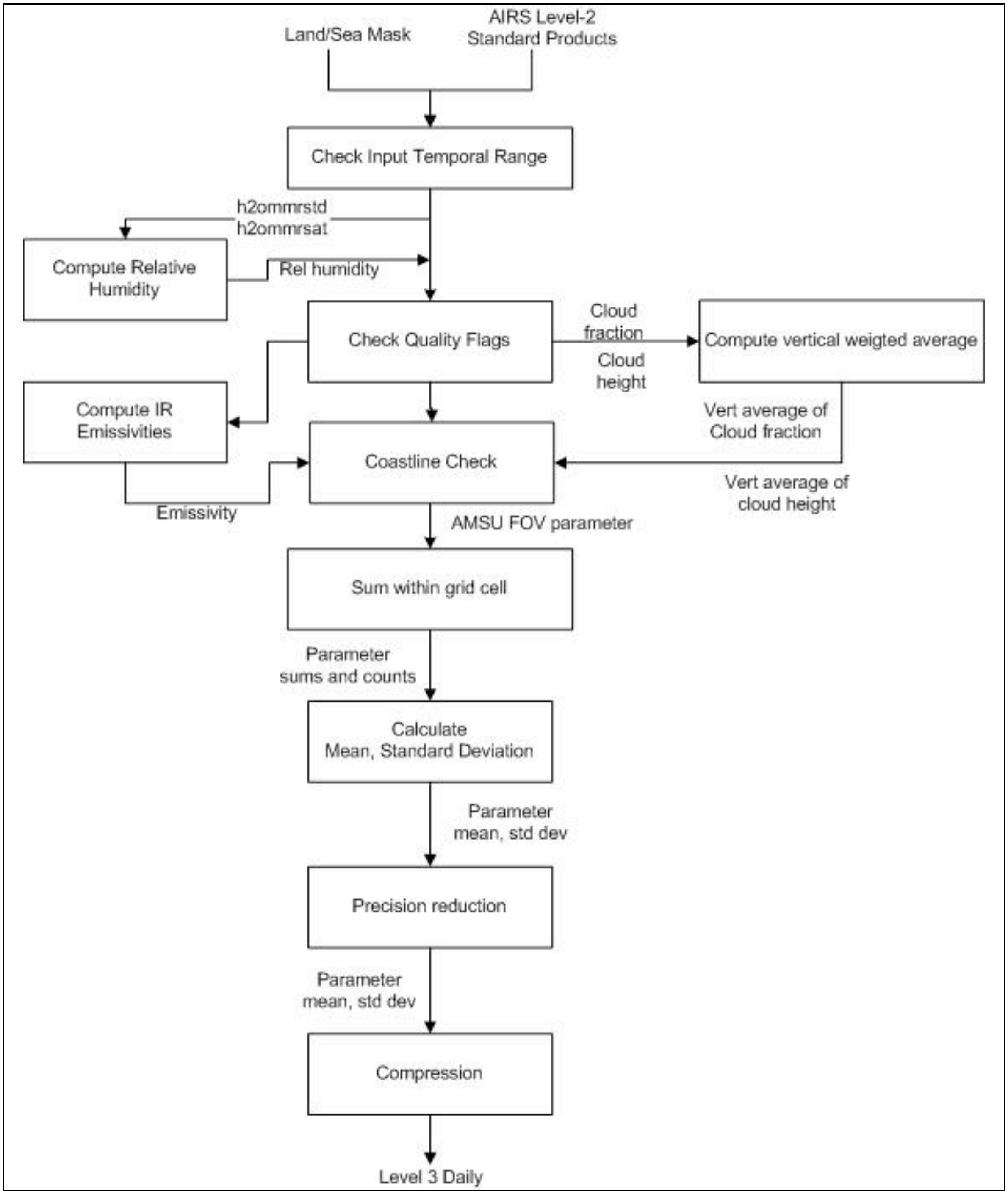


**Figure 10: AIRS Daily Level 3 Processing Flow**

## *Browse Processing*

As 240 granules of Level 1B and Level 2 data are produced for a day, a specialized set of products, termed Browse Products, are also produced each day for each Level 1B and Level 2 standard product. Each Browse Product is a simplification of data found within its associated standard product set. Summary Browse Products are high-level pictorial representations of AIRS Instrument (AIRS Infrared, AMSU-A and HSB) data binned in 1°x1° boxes, designed as an aid to ordering data from the GSFC DAAC or the EOS Data Gateway (EDG). By viewing AIRS Browse images, users will find it easier to select science granules that correspond to features of interest. Some users may also find Summary Browse images to be useful tools in their own right.

The AIRS Browse Products included in the data are:

| Data Set | Short Name | Granule Size |
|---|---|---|
| L1B AMSU selected radiances browse | AIRABDBR | 0.6 MB |
| L1B HSB radiance browse | AIRHBDBR | 0.3 MB |
| L1B AIRS selected radiances browse | AIRIBDBR | 0.4 MB |
| L2 Cloud-cleared selected radiances browse | AIRI2DBR | 0.4 MB |
| L2 retrieval browse | AIRX2DBR | 0.6 MB |

# V4.0 Release Data Information

## *Data Disclaimer and Quick Start Quality Assurance*

### Data Disclaimer

The accompanying file:

**Data_Disclaimer.pdf**

provides information which affects the availability of data for ordering (i.e., may be unavailable due to instrument outage or spacecraft maneuvering). It also lists the known liens against each instrument.

### Quick Start Quality Assurance

The accompanying file:

**L1B_QA_Quick_Start.pdf**

is a guide to the most basic L1B AIRS/AMSU/HSB quality assurance (QA) parameters that a novice user of AIRS/AMSU/HSB data should access to judge L1B Radiance Product quality.

A brief user guide for the selected L1B AIRS Radiance Product QA swath data fields is in the accompanying file:

**Select_AIRS_QA_Fields.pdf**

Please refer to the L2 Quality Flag Quick Start Documentation for a description of the various **Qual_*** flags.

**V4.0_L2_QualFlag_QuickStart.pdf**

# *Data Products*

The following is a quick guide to the contents of the data products which we believe are of greatest interest to the user.

## L1B AMSU Radiance Product

See Appendix A1-5 of **V4_Release_Proc_FileDesc.pdf** for a complete description. Please note that values of –9999 (if integer) and –9999.0 (if floating) denote invalid data.

**The geolocation data fields of immediate interest to the user are:**

- **Latitude**
  AMSU footprint boresight geodetic latitude
  (degrees North, -90->+90), dimension (30,45)
- **Longitude**
  AMSU footprint boresight geodetic longitude
  (degrees East, -180->+180), dimension (30,45)

**The per-granule data fields of immediate interest to the user are:**

- **center_freq**
  channel center frequency (GHz), dimension (15)
- **IF_offset_1**
  offset of first intermediate frequency stage (MHz)
  (zero for no mixing), dimension (15)
- **IF_offset_2**
  offset of second intermediate frequency stage (MHz)
  (zero for no second mixing), dimension (15)
- **Bandwidth**
  bandwidth of sum of 1,2 or 4 channels (MHz),
  dimension (15)

**The along-track data fields of immediate interest to the user are:**

- **qa_scanline**
  Bit field for each scanline (bit 0 set if sun glint in scanline; bit 1 set if costal crossing in scanline, bit 2 set if some channels had excessive NeDT estimated), dimension (45)
- **qa_channel**
  Bit field by channel for each scanline (bit 0 set if all space view counts bad; bit 1 set if space view counts marginal; bit 2 set if space view counts could not be smoothed; bit 3 set if all blackbody counts bad; bit 4 set if blackbody counts marginal; bit 5 set if blackbody counts could not be smoothed; bit 6 set if unable to calculate calibration coefficients; bit 7 set if excessive NeDT estimated), dimension (15,45)

**The swath data fields of immediate interest to user are:**

- **antenna_temp**
  calibrated, geolocated channel-by-channel AMSU observed raw antenna temperature (K), dimension (15,30,45)
- **brightness_temp**
  calibrated, geolocated channel-by-channel AMSU sidelobe-corrected antenna temperature (K). No sidelobe correction applied in V4, so equal to **antenna_temp**, dimension (15,30,45)
- **brightness_temp_err**
  error estimate for brightness_temp (K), do not use since no sidelobe correction applied in V4, dimension (15,30,45)
- **landFrac**
  fraction of AMSU footprint that is land (0.0 -> 1.0),
  dimension (30,45)
- **landFrac_err**
  error estimate for landFrac, dimension (30,45)

## L1B HSB Radiance Product

See Appendix A1-6 of **V4_Release_Proc_FileDesc.pdf** for a complete description. Please note that values of –9999 (if integer) and –9999.0 (if floating) denote invalid data.

**The geolocation data fields of immediate interest to the user are:**

- **Latitude**
  HSB spot boresight geodetic latitude
  (degrees North, -90->+90), dimension (90,135)
- **Longitude**
  HSB spot boresight geodetic longitude
  (degrees East, -180->+180), dimension (90,135)

**The per-granule data fields of immediate interest to the user are:**

- **center_freq**
  channel center frequency (GHz), dimension (5)
- **IF_offset_1**
  offset of first intermediate frequency stage (MHz)
  (zero for no mixing), dimension (5)
- **IF_offset_2**
  offset of second intermediate frequency stage (MHz)
  (zero for no second mixing), dimension (5)
- **Bandwidth**
  bandwidth of sum of 1,2 or 4 channels (MHz),
  dimension (5)

**The along-track data fields of immediate interest to the user are:**

- **qa_scanline**
  Bit field for each scanline (bit 0 set if sun glint in scanline; bit 1 set if costal crossing in scanline, bit 2 set if some channels had excessive NeDT estimated; bit 3 set if near sidelobe correction applied),
  dimension (135)
- **qa_receiver**
  Receiver bit field for each scanline (bit 0 set if calibration was not derived due to instrument mode in scanline; bit 1 set if calibration was not derived due to bad or missing PRT values in scanline, bit 2 set if scanline was calibrated but the Moon was in the space view; bit 3 set if scanline was calibrated but there was a space view scan position error; bit 4 set if scanline was calibrated but there was a blackbody view scan position

error; bit 5 set if scanline was calibrated but some PRT values were bad or marginal; bit 6 set if scanline calibrated but there was a data gap; bit 7 set if some channels were not calibrated), dimension (135)

- **qa_channel**
  Bit field by channel for each scanline (bit 0 set if all space view counts bad; bit 1 set if space view counts marginal; bit 2 set if space view counts could not be smoothed; bit 3 set if all blackbody counts bad; bit 4 set if blackbody counts marginal; bit 5 set if blackbody counts could not be smoothed; bit 6 set if most recent calibration coefficients used; bit 7 set if excessive NeDT estimated), dimension (15,135)

**The swath data fields of immediate interest to user are:**

- **antenna_temp**
  calibrated, geolocated channel-by-channel HSB observed raw antenna temperature (K), dimension (5,90,135)
- **brightness_temp**
  calibrated, geolocated channel-by-channel HSB sidelobe-corrected antenna temperature (K). No sidelobe correction applied in V4, so set equal to **antenna_temp**, dimension (5,90,135)
- **brightness_temp_err**
  error estimate for brightness_temp (K), do not use since no sidelobe correction applied in V4, dimension (5,90,135)
- **landFrac**
  fraction of HSB spot that is land (0.0 -> 1.0), dimension (90,135)
- **landFrac_err**
  error estimate for landFrac, dimension (90,135)

## L1B AIRS Radiance Product

See Appendix A1-1 of **V4_Release_Proc_FileDesc.pdf** for a complete description. Please note that values of –9999 (if integer) and –9999.0 (if floating) denote invalid data.

Users should consult the appropriate Channel Properties File, which provides the static quality indicators on a per-channel basis. Key indicators are the frequency centroids and widths, static NEdT, spatial centroids and **AB_state**. Please refer to the following documents for additional quality assurance information.

**Select_AIRS_QA_Fields.pdf**

**L1B_QA_Quick_Start.pdf**

**L2_QA_Quick_Start.pdf**

The L1B AIRS Radiance Product files contain dynamic quality indicators, on-the-fly estimates of noise and indicators of abnormal behavior by the instrument or algorithms.

**SUGGESTION TO USERS FOR CHOOSING CHANNELS TO USE IN RESEARCH:**

**Evaluate Candidate Channel Radiometrically**

- If AB_State > 2, in channel properties file, channel has known problems and should be avoided
- Pick a noise limit and filter out channels exceeding it using dynamic NeN
- Use nonzero CalChanSummary to filter out channels that are not well calibrated over the entire granule

**Evaluate Candidate Channel Spatially**

If sensitivity to channel co-registration is a concern:

- Use Cij and/or boresight centroids in the relevant channel properties file to filter out channels which are not sufficiently co-aligned, or
- Use the Sceneinhomogeneous flag, the Rdiff flags and/or the radiances themselves to restrict data selection to uniform scenes where co-registration is not an issue.

**The geolocation data fields of immediate interest to the user are:**

- **Latitude**
  AIRS spot boresight geodetic latitude
  (degrees North, -90->+90), dimension (90,135)
- **Longitude**
  AIRS spot boresight geodetic longitude
  (degrees East, -180->+180), dimension (90,135)

**The attribute of immediate interest to the user are:**

- **CalGranSummary**
  Bit field that is a bitwise OR of CalScanSummary. Zero means that all "good" channels were well calibrated in the entire granule, dimension (1)

**The per-granule data fields of immediate interest to the user are:**

- **CalChanSummary**
  Bit field that is a bitwise OR of CalFlag by channel over all scanlines. Zero means that channel was well calibrated in the entire granule, dimension (2378)
- **ExcludedChans**
  Bit field that indicates A/B detector weights,
  dimension (2378)
- **NeN**
  Noise equivalent radiance for each channel for an assumed 250 K scene (milliWatts/$m^2$/$cm^{-1}$/steradian), dimension (2378)
- **nominal_freq**
  nominal frequencies of each channel ($cm^{-1}$),
  **USE THIS FOR FREQUENCIES**, dimension (2378)
- **spectral_freq**
  calculated frequencies of each channel ($cm^{-1}$),
  noisy since determined using single granule, dimension (2378)
- **spectral_freq_unc**
  uncertainty in calculated frequencies($cm^{-1}$),
  noisy since determined using single granule, dimension (2378)

**The along-track data fields of immediate interest to the user are:**

- **CalFlag**
  Bit field by channel for each scanline. Zero means the channel was well calibrated, dimension (2378,135)
- **CalScanSummary**
  Bit field that is a bitwise OR over the good channel list (i.e., channels not in ExcludedChans). Zero means that all “good” channels were well calibrated for a scanline, dimension (135)

**The swath data fields of immediate interest to user are:**

- **radiances**
  calibrated, geolocated channel-by-channel AIRS observed infrared spectra (milliWatts/$m^2$/$cm^{-1}$/steradian), dimension (2378,90,135)
- **landFrac**
  fraction of AIRS spot that is land (0.0 -> 1.0),
  dimension (90,135)
- **landFrac_err**
  error estimate for landFrac, dimension (90,135)
- **sun_glint_distance**
  distance from AIRS spot center to location of sun glint; -9999 if unknown and 30000 for no glint visible because
  platform is in the Earth’s shadow (km), dimension (90,135)
- **solzen**
  solar zenith angle (degrees, 0->180; daytime if < 85),
  dimension (90,135)
- **Sceneinhomogeneous**
  flag using band-overlap detectors which is set non-zero if the scene is inhomogeneous as determined by Rdiff_swindow, Rdiff_lwindow or Rdiff_strat, dimension (90,135)
- **Rdiff_swindow**
  radiance difference in the 2560 $cm^{-1}$ window region, used to warn of possible errors caused by scene non-uniformity and misalignment of the beams (milliWatts/$m^2$/$cm^{-1}$/steradian),
  dimension (90,135)
- **Rdiff_lwindow**
  radiance difference in the 850 $cm^{-1}$ window region, used to warn of possible errors caused by scene non-uniformity and misalignment of the beams (milliWatts/$m^2$/$cm^{-1}$/steradian),
  dimension (90,135)

## L1B Visible/NIR Radiance Product

See Appendix A1-4 of **V4_Release_Proc_FileDesc.pdf** for a complete description. Please note that values of –9999 (if integer) and –9999.0 (if floating) denote invalid data.

**The geolocation data fields of immediate interest to the user are:**

- **Latitude**
  AIRS spot boresight geodetic latitude
  (degrees North, -90->+90), dimension (90,135)
- **Longitude**
  AIRS spot boresight geodetic longitude
  (degrees East, -180->+180), dimension (90,135)

**The attribute of immediate interest to the user are:**

- **VISDarkAMSUFOVCount**
  number of AMSU-A footprints in the granule that are uniformly dark in the L1B VIS/NIR and are thus likely to be uniformly clear, dimension (1)
- **VISBrightAMSUFOVCount**
  number of AMSU-A footprints in the granule that are uniformly bright in the L1B VIS/NIR and are thus likely to be uniformly cloudy, dimension (1)

**The per-granule data fields of immediate interest to the user are:**

- **gain**
  number of radiance units per count, dimension (9,4)
- **gain_err**
  error estimate for number of radiance units per count caused by imperfect fit for gain, dimension (9,4)

**The along-track data fields of immediate interest to the user are:**

- **NeN**
  noise equivalent radiance for each channel (Watts/m$^2$/micron/steradian), dimension (9,4,135)

**The swath data fields of immediate interest to user are:**

- **radiances**
  calibrated, geolocated channel-by-channel radiances for each channel (Watts/$m^2$/micron/steradian), dimension (8,9,4,90,135)
- **landFrac**
  fraction of AIRS spot that is land (0.0 -> 1.0),
  dimension (90,135)
- **landFrac_err**
  error estimate for landFrac, dimension (90,135)
- **sun_glint_distance**
  distance from AIRS spot center to location of sun glint; -9999 if unknown and 30000 for no glint visible because
  platform is in the Earth's shadow (km), dimension (90,135)
- **solzen**
  solar zenith angle (degrees, 0->180; daytime if < 85),
  dimension (90,135)

## L2 Standard Product

See Appendix A1-7 of **V4_Release_Proc_FileDesc.pdf** for a complete description. Please note that values of –9999 (if integer) and –9999.0 (if floating) denote invalid data.

Please read the document that discusses the finer points of AIRS products defined on levels, layers, TOA and surface.

**AIRS_L2_levels_and_layers.pdf**

**SUGGESTION TO USERS FOR CHOOSING DATA TO USE IN RESEARCH:**

Casual users may simply filter FOVs through a test on **RetQAFlag** , eliminating from consideration any FOV for which this flag is nonzero. This is the “all or nothing” approach to FOV selection.

More hands-on users may employ the various **Qual_*** flags to include in their data sample valid products which are found in FOVs for which **RetQAFlag** is nonzero. The yield of products at higher altitudes will be increased greatly over that resulting from the simpler filter that only uses **RetQAFlag**.

Please refer to the L2 Quality Flag Quick Start Documentation for a description of the various **Qual_*** flags.

**V4.0_L2_QualFlag_QuickStart.pdf**

**The geolocation data fields of immediate interest to the user are:**

- **Latitude**
  FOV boresight geodetic latitude
  (degrees North, -90->+90), dimension (30,45)
- **Longitude**
  FOV boresight geodetic longitude
  (degrees East, -180->+180), dimension (30,45)

**The per-granule data fields of immediate interest to the user are:**

- **pressStd**
  standard pressure (mb) for each of 28 levels in atmosphere associated with temperature, moisture and ozone profiles. **The array order is from the surface upward, in conformance with WMO standard**. Note that topography may place some of these levels below the surface, dimension (28)
- **MWHingeSurfFreqGHz**
  frequencies in GHz for MW Surface parameters, dimension (7)

**The swath data fields of immediate interest to the user are:**

- **RetQAFlag**
  casual users should always check this "all or nothing" quality indicator and require that it be zero for inclusion in their analyses,
  dimension (30,45)
- **Qual_***
  flags identifying the quality of the various retrieved products in three altitude regimes (TOA to 200mb, 200mb to 3km, 3km to surface), hands-on users should always check the quality indicator which is appropriate to the retrieval product in question. **Set to zero indicates highest quality, set to 1 indicates good quality, set to 2 means do not use**,
  dimension (30,45)
  - **Qual_MW_Only_Temp_Strat**
    overall quality flag for MW-only temperature fields for altitudes above 201 mb
  - **Qual_MW_Only_Temp_Tropo**
    overall quality flag for MW-only temperature fields for altitudes at or below 201 mb
  - **Qual_MW_Only_H2O**
    overall quality flag for MW-only water fields (both vapor and liquid)
  - **Qual_Cloud_OLR**
    overall quality flag for cloud parameters and clear and cloudy OLR
  - **Qual_H2O**
    overall quality flag for water vapor fields. **IGNORE, nder development. Use Qual_Temp_Profile_* QA flags**.
  - **Qual_O3**
    quality flag for ozone fields
  - **Qual_Temp_Profile_Top**
    quality flag for temperature profile at and above **Press_mid_top_bndry**
  - **Qual_Temp_Profile_Mid**
    quality flag for temperature profile between **Press_mid_top_bndry** and **Press_bot_mid_bndry**

  - **Qual_Temp_Profile_Bot**
    quality flag for temperature profile below **Press_bot_mid_bndry**, including surface air temperature
  - **Qual_Surf**
    overall quality flag for surface fields including surface temperature, emissivity and reflectivity
  - **Qual_Guess_PSurf**
    quality flags for surface pressure guess input (0 indicates from timely forecast, 1 indicates from climatology, 2 indicates do not use)
- **MW_ret_used**
  MW-only final retrieval used if nonzero, i.e., IR information discarded, dimension (30,45)
- **Initial_CC_score**
  indicator of how well the initial cloud-cleared radiances match radiances reconstructed from clear eigenvectors (unitless), dimension (30,45)
  - 0.33 is best possible score, a 3X noise reduction
  - < 0.8 indicates a very good match
  - < 3.0 indicates a pretty good match
  - > 10.0 indicates a major discrepancy
- **landFrac**
  fraction of FOV that is land (0.0 -> 1.0),
  dimension (30,45)
- **landFrac_err**
  error estimate for landFrac, dimension (30,45)
- **sun_glint_distance**
  distance from FOV center to location of sun glint; -9999 if unknown and 30000 for no glint visible because
  platform is in the Earth's shadow (km), dimension (30,45)
- **solzen**
  solar zenith angle (degrees, 0->180; daytime if < 85),
  dimension (30,45)
- **topog**
  mean topography in FOV above reference ellipsoid (m), dimension (30,45)
- **topog_err**
  error estimate for topog (m), dimension (30,45)
- **latAIRS**
  geodetic center latitude of AIRS spots(degrees East, -180->+180) associated with this FOV, dimension (3,3,30,45)
- **lonAIRS**
  geodetic center longitude of AIRS spots(degrees North, -90->+90) associated with this FOV, dimension (3,3,30,45)
- **PsurfStd**
  surface pressure, interpolated from forecast and mean topography of FOV (mb), dimension (30,45)

- **nSurfStd**
  index of last physically meaningful profile entries. Retrieved profile entries beyond this index are filled with –9999. It is the first level above the mean surface (1, 2, …, 15), dimension (30,45)
- **Press_mid_top_bndry**
  pressure level (mb) at or above which the quality of the temperature profile is given by **Qual_Temp_Profile_top**. Below this level use **Qual_Temp_Profile_mid**, dimension (30,45)
- **nStd_mid_top_bndry**
  index of standard pressure level nearest to **Press_mid_top_bndry** (1, …, 28), dimension (30,45)
- **Press_bot_mid_bndry**
  pressure level (mb) at and below which the quality of the temperature profile is given by **Qual_Temp_Profile_bot**. Above this level use **Qual_Temp_Profile_mid**, dimension (30,45)
- **nStd_bot_mid_bndry**
  index of standard pressure level nearest to **Press_bot_mid_bndry** (1, …, 28), dimension (30,45)
- **TSurfStd**
  retrieved surface skin temperature (K), dimension (30,45)
- **TSurfAir**
  retrieved surface air temperature (K), dimension (30,45)
- **Press_valid_bottom**
  bottom pressure (mb) at which temperature, water vapor and ozone profiles are valid, dimension (30,45)
- **totH2OStd**
  total precipitable water vapor in air column ($kg/m^2$), dimension (30,45)
- **totH2OMWOnlyStd**
  MW-only total precipitable water vapor in air column ($kg/m^2$), dimension (30,45)
- **totO3Std**
  total ozone burden in air column (Dobson Units), dimension (30,45)
- **TAirStd**
  retrieved atmospheric temperature profile (K) at the **pressStd** pressures. Array values below the surface (index < **nSurfStd**) may be filled with nonphysical extrapolated values. Always check **nSurfStd** to avoid invalid TAirStd elements and use **TSurfAir** for the surface air temperature, dimension (28,30,45)
- **TAirMWOnlyStd**
  MW-only retrieved atmospheric temperature profile (K) at the **pressStd** pressures. Array values below the surface (index < **nSurfStd**) may be filled with nonphysical extrapolated values. Always check **nSurfStd** to avoid invalid **TAirStd** elements and use **TSurfAir** for the surface air temperature, dimension (28,30,45)

- **H2OMMRStd**
  **layer-averaged** retrieved water vapor mass mixing ratio (gm/kg_dry_air). Array values below the surface (index < **nSurfStd**) may not always be filled with –9999.0. Always check **nSurfStd** to avoid invalid **H2OMMRStd** elements below the surface, dimension (28,30,45)
- **H2OMMRSat**
  retrieved water vapor saturation mass mixing ratio (gm/kg_dry_air). Array values below the surface (index < **nSurfStd**) may not always be filled with –9999.0. Always check **nSurfStd** to avoid invalid **H2OMMRSat** elements below the surface, dimension (28,30,45)
- **O3VMRStd**
  **layer-averaged** retrieved ozone volume mixing ratio (vmr). Array values below the surface (index < **nSurfStd**) may not always be filled with –9999.0. Always check nSurfStd to avoid invalid O3VMRStd elements below the surface, dimension (28,30,45)
- **MWSurfClass**
  surface class from MW-only stage, dimension (30,45)
  - 0 for coastline (liquid water covers 1%->50% of FOV)
  - 1 for land (liquid water covers <1% of FOV)
  - 2 for ocean (liquid water covers >50% of FOV)
  - 3 for sea ice (high-emissivity)
  - 4 for sea ice (low-emissivity)
  - 5 for snow (higher frequency scattering)
  - 6 for glacier/snow (very low frequency scattering)
  - 7 for snow (lower-frequency scattering
  - -1 or 255 for unknown
- **numHingeSurf** number of IR hinge points for retrieved surface emissivity and reflectivity. It can be as large as 100. Usually 7, 49 or 51 depending upon the retrieval outcome. A MW-only retrieval results in 7. A full MW/IR retrieval results in 49. A partial MW/IR retrieval results in 51. dimension (30,45)
- **freqEmis** Frequencies ($cm^{-1}$) for retrieved surface emissivity and reflectivity in order of increasing emissivity. Only the first numHingeSurf are valid, dimension (100,30,45)
- **emisIRStd** The retrieved spectral IR surface emissivity in order of increasing frequency. Only the first numHingeSurf are valid, dimension (100,30,45)
- **rhoIRStd** The retrieved spectral IR bi-directional surface reflectivity in order of increasing frequency. Only the first numHingeSurf are valid, dimension (100,30,45)
- **sfcTbMWStd**
  MW-only surface brightness (K), emitted radiance only (reflected radiance not included) at the **MWHingeSurf** frequencies, dimension (7,30,45)

- **EmisMWStd**
  MW-only spectral emissivity at the **MWHingeSurf** frequencies, dimension (= **sfcTbMWStd/TsurfStd** or undefined if no IR retrieval), dimension (7,30,45)
- **NumCloud** number of retrieved cloud layers (= 0, 1 or 2), dimension (30,45)
- **TcldTopStd** retrieved cloud top temperature (K) for each of up to two retrieved cloud layers, uppermost layer first, dimension (2,30,45)
- **PcldTopStd** retrieved cloud top pressure (mb) for each of up to two retrieved cloud layers, uppermost layer first, dimension (2,30,45)
- **CldFrcStd** retrieved cloud fraction (0->1) for each AIRS footprint associated with the retrieval FOV, for each layer, dimension (2,3,3,30,45)
- **All_spots_avg**
  cloud-clearing status
  - 0 indicates cloud-clearing was applied to the 9 AIRS radiances
  - 1 indicates cloud-clearing algorithm judged the scene to be clear enough to simply average all 9 AIRS spots radiances
  - -1 or 255 indicates cloud-clearing was not attempted
- **olr**
  outgoing longwave radiation flux integrated over 2 $cm^{-1}$ to 2800 $cm^{-1}$ ($Watts/m^2$), dimension (30,45)
- **olr_err**
  error estimate for **olr** ($Watts/m^2$), dimension (30,45)
- **clrolr**
  clear-sky outgoing longwave radiation flux integrated over 2 $cm^{-1}$ to 2800 $cm^{-1}$ ($Watts/m^2$), dimension (30,45)
- **clrolr_err**
  error estimate for **clrolr** ($Watts/m^2$), dimension (30,45)
- **clear_flag_4um** a flag indicating clear FOV valid over ocean only at night, which is based on the agreement of the predicted SST using observed AIRS radiance at 2616 $cm^{-1}$ and 2707 $cm^{-1}$ and the coherency among the 9 AIRS spots in the FOV at 2616 $cm^{-1}$,. A value of 1 indicates possibly clear. **<u>Ignore</u>, under development**, dimension (3,3,30,45)
- **clear_flag_11um** a flag indicating clear FOV valid over ocean day and night, which is based on the agreement of the predicted SST using AIRS 11 um split window test and the coherency among the 9 AIRS spots in the FOV. A value of 1 indicates possibly clear. **<u>Ignore</u>, under development**, dimension (3,3,30,45)
- **clear_flag** a flag indicating clear FOV derived in the final retrieval step. **<u>Ignore</u>, under development**, dimension (30,45).

Figure 11 illustrates representative physical retrieval data fields from the example FOV. These data are contained in the L2 Standard Product. The upper panels (left to right) are respectively **TAirStd**, **H2OMMRStd**, **O3VMRStd**, and **emisIRStd**. The temperature, moisture and ozone plots also show the estimated errors as error bars on the points. The temperature plot also includes **TcldTopStd** and **TsurfStd** and their errors. AIRS radiances are relatively insensitive to water vapor in the stratosphere. This figure was created from V3.0 data, when the retrieval algorithm reports a climatological water vapor profile above the tropopause. A dry layer near 100 mb would occasionally be seen in that version, as in the **H2OMMRStd** panel, and was an artifact of combining a retrieval in the troposphere with a climatological water vapor profile in the stratosphere. **<u>This has been corrected in the V4.0 delivery algorithm</u>**.

The lower panel give **PcldTopStd** and T**cldTopStd** and graphical representations of **CldFrcStd** and **CldFrcStderr**. A completely filled circle would indicate CldFrcStd = 1.0. Errors are indicated by the arcs. A single cloud formation (at 429.6 mb) was retrieved, and AIRS spot #9 (color-coded brown) is indeed the cloudiest. AIRS spot #4 (color coded magenta) is the least cloudy.

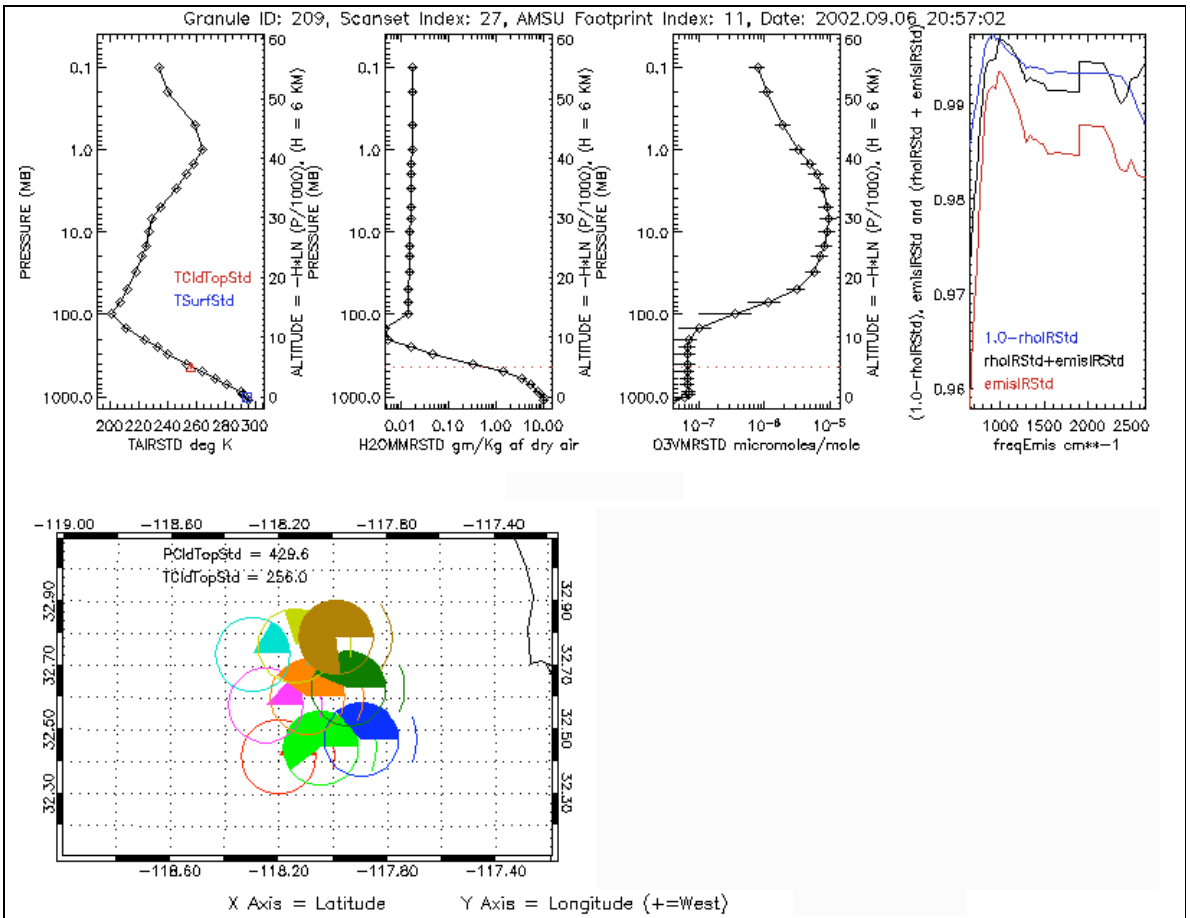


**Figure 11: Data Fields from Level 2 Standard Product**
**Sept 6, 2002; Granule 209; Scanset 27; Footprint 11**

## L2 Cloud-Cleared Radiance Product

See Appendix A1-8 of **V4_Release_Proc_FileDesc.pdf** for a complete description. Please note that values of –9999 (if integer) and –9999.0 (if floating) denote invalid data.

**SUGGESTION TO USERS FOR CHOOSING DATA TO USE IN RESEARCH:**

**Evaluate candidate channel as described for AIRS L1B Radiance Product**

**Evaluate Qual_CC_Rad for FOV**

- Researchers should use radiances only from FOVs in which **Qual_CC_Rad** = 0
- FOVs in which **Qual_CC_Rad** = 1 may be sufficiently accurate for statistical studies, but results should be carefully checked
- FOVs in which **Qual_CC_Rad** = 2 must be avoided

**The geolocation data fields of immediate interest to the user are:**

- **Latitude**
  FOV boresight geodetic latitude
  (degrees North, -90->+90), dimension (30,45)
- **Longitude**
  FOV boresight geodetic longitude
  (degrees East, -180->+180), dimension (30,45)

**The attribute of immediate interest to the user are:**

- **CalGranSummary**
  Bit field that is a bitwise OR of **CalScanSummary**. Zero means that all “good” channels were well calibrated in the entire granule, dimension (1)

**The per-granule data fields of immediate interest to the user are:**

- **CalChanSummary**
  Bit field that is a bitwise OR of **CalFlag** by channel over all scanlines. Zero means that channel was well calibrated in the entire granule, dimension (2378)
- **ExcludedChans**
  Bit field that indicates A/B detector weights, dimension (2378)
- **NeN**
  Noise equivalent radiance for each channel for an assumed 250 K scene (milliWatts/$m^2$/$cm^{-1}$/steradian), dimension (2378)
- **nominal_freq**
  nominal frequencies of each channel ($cm^{-1}$), dimension (2378)
- **freq**
  frequencies associated with each channel ($cm^{-1}$), dimension (2378)
- **NeN_L1B**
  Level 1B noise equivalent radiances for an assumed 250 K scene. Note that effective noise on cloud-cleared radiances will be modified (milliWatts/$m^2$/$cm^{-1}$/steradian), dimension (2378)

**The along-track data fields of immediate interest to the user are:**

- **CalFlag**
  Bit field by channel for each scanline. Zero means the channel was well calibrated, dimension (2378,45)
- **CalScanSummary**
  Bit field that is a bitwise OR over the good channel list (i.e., channels not in ExcludedChans). Zero means that all “good” channels were well calibrated for a scanline, dimension (45)

**The swath data fields of immediate interest to user are:**

- **Qual_CC_Rad**
  overall quality flag for cloud-cleared radiances. 0 indicates highest quality; 1 indicates good quality; 2 means do not use, dimension (30,45)
- **radiances**
  cloud-cleared channel-by-channel observed infrared spectra that would have been observed over FOV in absence of clouds (milliWatts/$m^2$/$cm^{-1}$/steradian), dimension (2378,30,45)

- **radiance_err**
  error estimate for radiances (milliWatts/$m^2$/$cm^{-1}$/steradian),
  dimension (2378,30,45)
- **CldClearParam**
  cloud-clearing parameter eta, dimension (3,3,30,45)
- **landFrac**
  fraction of FOV that is land (0.0 -> 1.0),
  dimension (30,45)
- **landFrac_err**
  error estimate for landFrac, dimension (30,45)
- **sun_glint_distance**
  distance from FOV center to location of sun glint; -9999 if unknown and 30000 for no glint visible because
  platform is in the Earth's shadow (km), dimension (30,45)
- **solzen**
  solar zenith angle (degrees, 0->180; daytime if < 85),
  dimension (30,45)
- **scanang**
  scanning angle of AIRS instrument with respect to the spacecraft for this FOV, negative at start of scan and zero at nadir (degrees, -180->180),
  dimension (30,45)

Figure 12 shows the AIRS Level 2 cloud-cleared radiance spectrum (**radiances**) from the example FOV converted to brightness temperature. These data contained in the L2 Cloud-Cleared Radiance Product.

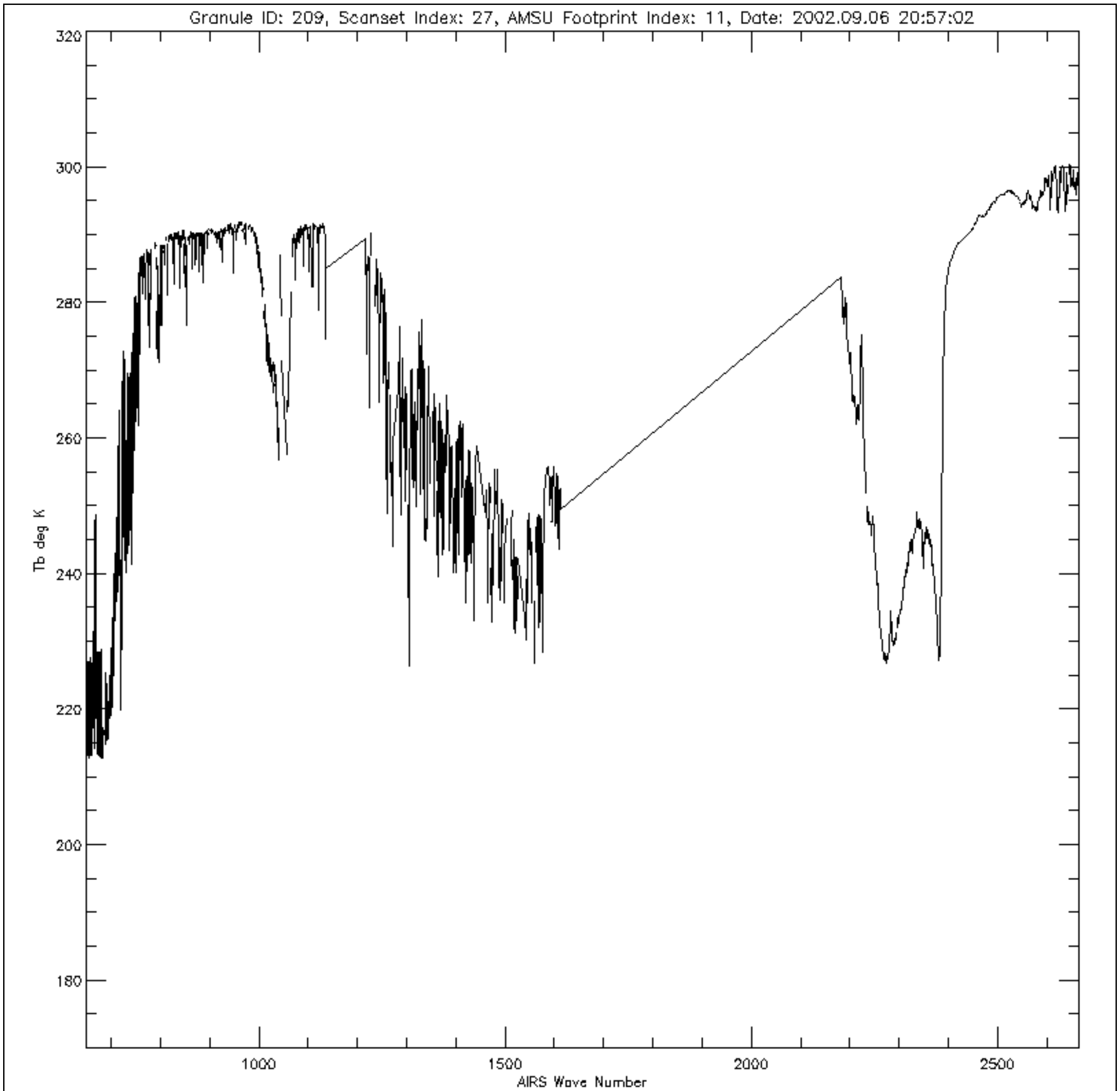


**Figure 12: Level 2 Cloud-Cleared Infrared Radiance Spectrum (AIRS) Sept 6, 2002; Granule 209; Scanset 27; Footprint 11**

Figure 13 illustrates the magnitude of the difference between the final Level 2 cloud-cleared radiance spectrum reported for the example FOV and the nine observed L1B AIRS radiance spectra. The bulk of this difference is due to the effect of clouds, which is removed during the Level 2 processing. The cloudiest AIRS footprint was spot #9 (color-coded in Figures 2,4,5 and 8 by brown). The least cloudy was spot #4 (color-coded in Figures 2,4,5 and 8 by magenta).

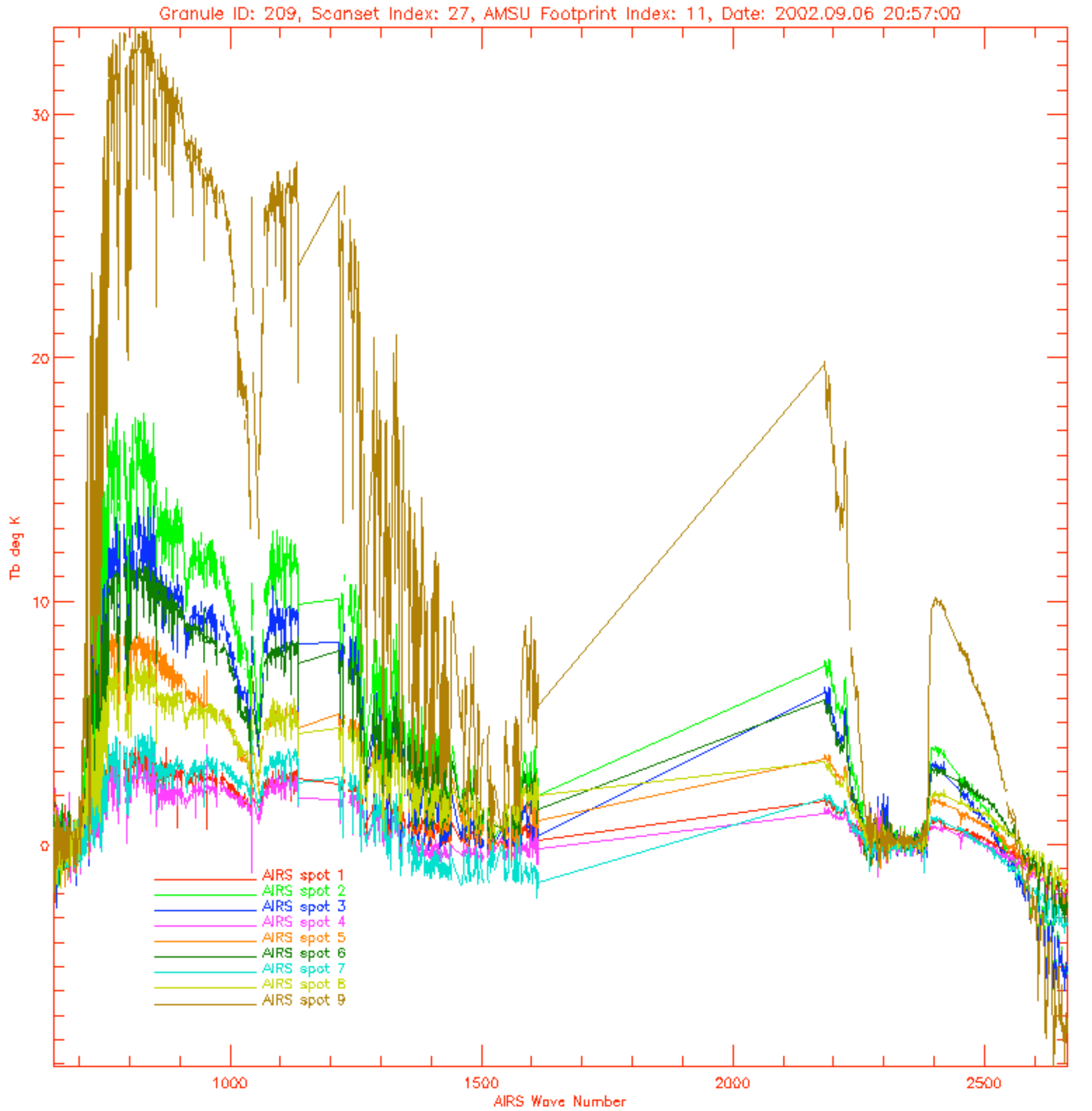


**Figure 13: (L2 Cloud-Cleared Spectrum – L1B Observed Spectra)**
**Sept 6, 2002; Granule 209; Scanset 27; Footprint 11**

## L2 Support Product

See Appendix A1-9 of **V4_Release_Proc_FileDesc.pdf** for a complete description. Please note that values of –9999 (if integer) and –9999.0 (if floating) denote invalid data. General users are urged to order the L2 Standard Product. The L2 Support Product is intended for the knowledgeable, experienced user of AIRS products. It contains high-resolution profiles to be used for computation of radiances, as-yet unimplemented research products and various parameters and intermediate results used to evaluate and track the progress of the retrieval algorithm.

**WARNING – PROFILES FOR WHICH RETQAFLAG IS NONZERO CONTAIN DIAGNOSTIC PARTIAL RESULTS WHICH ARE NONPHYSICAL.**

Please read the document that discusses the finer points of AIRS products defined on levels, layers, TOA and surface:

**AIRS_L2_levels_and_layers.pdf**

**The geolocation data fields of immediate interest to the user are:**

- **Latitude**
  FOV boresight geodetic latitude
  (degrees North, -90->+90), dimension (30,45)
- **Longitude**
  FOV boresight geodetic longitude
  (degrees East, -180->+180), dimension (30,45)

**The per-granule data fields of immediate interest to the user are:**

- **pressSupp**
  support pressure (mb) for each of 100 levels in atmosphere associated with temperature, moisture and ozone profiles. **The array order is from the top of atmosphere downward**. This is the reverse of **pressStd** ordering. Note that topography may place some of these levels below the surface, dimension (100)

**The swath data fields that are not part of the L2 Standard Product and may be of interest to the user are:**

- **PsurfStd**
  first guess surface pressure, interpolated from forecast and mean topography of FOV (mb), dimension (30,45)
- **nSurfSup**
  index of first pressure level above the mean surface (90, …, 100), dimension (30,45)
- **TAirSup**
  retrieved atmospheric temperature profile (K) at the **pressSupp** pressures. Array values below the surface (index < **nSurfStd**) are not physically meaningful. In particular, the first level below the surface contains an extrapolated value. Always check **nSurfSup** to identify where extrapolated values begin. The surface value (at **PsurfStd**) must be calculated by interpolating in the log(pressure) domain between this value and the value in the next level up (index = **nSurfSup**-1), dimension (100,30,45)
- **TAirMWOnly**
  MW-only retrieved atmospheric temperature profile (K), dimension (100,30,45)
- **H2OCDSup**
  Retrieved layer column water vapor (molecules/cm$^{-2}$). The layer corresponding to value **H2OCDSup**(index) is bounded by **pressSupp**(index) at the bottom and **pressSupp**(index-1) at the top. Array values below the surface (index < **nSurfStd**) are not physically meaningful. In particular, the first level below the surface contains an extrapolated value. Always check **nSurfSup** to identify where extrapolated values begin. The surface value (at **PsurfStd**) must be calculated by interpolating in the log(pressure) domain between this value and the value in the next level up (index = **nSurfSup**-1), dimension (100,30,45)
- **H2OCDMWOnly**
  **layer-averaged** MW-only retrieved column water vapor, dimension (100,30,45)
- **lwCDSup**
  Retrieved layer column cloud liquid water (molecules/cm$^{-2}$). The layer corresponding to value **lwCDSup**(index) is bounded by **pressSupp**(index) at the bottom and **pressSupp**(index-1) at the top. Array values below the surface (index < **nSurfStd**) are not physically meaningful. In particular, the first level below the surface contains an extrapolated value. Always check **nSurfSup** to identify where extrapolated values begin. The surface value (at **PsurfStd**) must be calculated by interpolating in the log(pressure) domain between this value

and the value in the next level up (index = **nSurfSup**-1). Missing if HSB instrument is not operational, dimension (100,30,45)

- **O3CDSup**
  Retrieved layer column ozone (molecules/$cm^{-2}$). The layer corresponding to value **O3CDSup**(index) is bounded by **pressSupp**(index) at the bottom and **pressSupp**(index-1) at the top. Array values below the surface (index < **nSurfStd**) are not physically meaningful. In particular, the first level below the surface contains an extrapolated value. Always check **nSurfSup** to identify where extrapolated values begin. The surface value (at **PsurfStd**) must be calculated by interpolating in the log(pressure) domain between this value and the value in the next level up (index = **nSurfSup**-1), dimension (100,30,45)

## Level 3 Data Products

See Appendix A3 of **V4_Release_Proc_FileDesc.pdf** for a complete description.. Please note that values of –9999 (if integer) and –9999.0 (if float) or a count of 0 indicate invalid or missing data.

**The location data fields of immediate interest to the user are:**

- **Latitude**
  geodetic latitude of center of grid box
  (degrees north, -90. to +90.), dimension (360,180)
- **Longitude**
  geodetic longitude of center of grid box
  (degrees East, -180. to +180.), dimension (360,180)
- **LandSeaMask**
  unitless, (1 = land, 0 – ocean), dimension (360,180)

Note: the grid box resolution on the surface of the Earth is 1°x1°
the upper left point corresponds to –180.0, 90.0
the lower right point corresponds to 180.0, -90.0
the projection is GCTP-GEO

**The attributes of immediate interest to the user are:**

- **NumOfDays**
  total number of days of input Level 2 data included in gridded maps.
- **AscendingGridStartTimeUTC**
  begin time of mapped fields (UTC), ascending.
- **AscendingGridEndTimeUTC**
  end time of mapped fields (UTC), ascending.
- **DescendingGridStartTimeUTC**
  begin time of mapped fields (UTC), descending.
- **DescendingGridEndTimeUTC**
  end time of mapped fields (UTC), descending.
- **TempPresLvlNum**
  standard pressure (mb) for each of 24 levels in the atmosphere associated with temperature profiles and geopotential height. The array order is from the surface upward, in conformance with WMO standard. Note that the Level-3 pressure levels are a subset of Level-2 pressure levels and are constrained to begin at 1000.0 mb and end at 1.0 mb

- **H2OpresLvlnum**
  standard pressure (mb) for each of 12 layers in the atmosphere associated with AIRS Level-3 water vapor profiles. The array order is from surface upward in accordance with the WMO standard. Note that Level-3 pressure levels for water vapor are constrained to be between 1000.0 and 100.0 mb.

**The ascending and descending grid fields are:**

- **TotalCounts_A, TotalCounts_D.**
  The total counts of non-missing (-9999) points that fell within grid cell, whether included in the final L3 product or not. Used for QC, dimension (360,180).
- **Temperature_A, Temperature_D**
  Atmospheric temperature profile (K) at 24 standard pressure levels: 1000 - 1 mb., dimension (360,180,24)
- **GPHeight_A, GPHeight_D**
  Geopotential height (meters) at 24 standard pressure levels: 1000 - 1 mb., dimension (360,180,24)
- **H2OVapMMR_A, H2OVapMMR_D**
  Water vapor mass mixing ratio (gm/kg dry air) at 12 layers: 1000 – 100 mb, dimension (360,180,12)
- **RelHumid_A, RelHumid_D**
  Relative humidity (percent) at 12 layers: 1000 – 100 mb, dimension (360,180,12)
- **TotO3_A, TotO3_D**
  total integrated column ozone burden (Dobson Units), dimension (360,180)
- **SurfPres_A, SurfPres_D**
  Mean surface pressure (mb), dimension(360,180).
- **TotCldLiqH2O_A, TotCldLiqH2O_D**
  Total integrated column cloud liquid water (kg/$m^2$), dimension (360,180)
- **SurfAirTemp_A, SurfAirTemp_D**
  Surface air temperature (K), dimension (360,180)
- **SurfSkinTemp_A, SurfSkinTemp_D**
  Surface skin temperature (K), dimension(360,180)
- **CloudTopPress_A, Cloud_Top_Press_D**
  Combined cloud top pressure (mb) weighted by cloud fraction, dimension (360,180)
- **CloudFrc_A, CloudFrc_D**
  Combined layer cloud fraction (unitless), dimension(360,180)
- **OLR_A, OLR_D**
  Outgoing long-wave radiation flux (watts/$m^2$), dimension (360,180)

- **OLR_clear_A, OLR_clear_D**
  Clear-sky outgoing long-wave radiation flux (watts/$m^2$), dimension(360,180)
- **EmisIR_A, EmisIR_D**
  IR surface emissivity (unitless) on a frequency grid (832, 961, 1203, 2616 $cm^{-1}$), dimension(360,180,4)
- **CldFrcVis_A**
  Fraction of visible pixels. ***Ascending nodes only,*** dimension (360,180)

**The ascending_MW_only and descending MW_only grid fields are:**

- **TotalCounts_A, TotalCounts_D**
  The total counts of non-missing (-9999) points that fell within grid cell, whether included in the final L3 product or not. Used for QC, dimension (360,180).
- **Temperature_MW_A, Temperature_MW_D**
  Atmospheric temperature profile (K) measured by AMSU at 24 standard pressure levels: 1000.0 – 1.0 mb, dimension(360,180,24)
- **GPHeight_MW_A, GPHeight_MW_D**
  Geopotential height (meters) at standard pressure levels: 1000 – 1 mb, dimension (360,180,24)
- **EmisMW_MW_A, EmisMW_MW_D**
  MW spectral emissivity (unitless) on a frequency grid (23.8, 50.3, & 89.0 GHz), dimension (360,180,3)
- **TotH2O_Vap_MW_A, TotH2O_Vap_MW_D**
  Total integrated column water vapor burden (kg/$m^2$), dimension (360,180).

## L1B Summary Browse Products

L1B Summary Browse Products represent a twice-daily global snapshot of selected AIRS/AMSU/HSB observed radiances for selected data channels, one for ascending (daytime) nodes and one for descending (nighttime) nodes. This browse consists of the following observed radiance products averaged over a 1x1 degree grid cell:

Observed AMSU-A Radiances

- Channel 1 23.8 GHz, measures atmospheric temperature and surface condition
- Channel 2 31.4 GHz, measures atmospheric temperature and surface condition
- Channel 3 50.3 GHz, measures atmospheric temperature
- Channel 4 52.8 GHz, measures atmospheric temperature
- Channel 5 53.596 ± 1.15 GHz, measures atmospheric temperature
- Channel 6 54.4 GHz, measures atmospheric temperature
- Channel 7 54.94 GHz, measures atmospheric temperature
- Channel 15 89.0 GHz, measures water vapor

Observed HSB Radiances (Collection 3 only)

- Channel 2 150.0 GHz, measures water vapor
- Channel 3 183.31 ± 1.0 GHz, measures water vapor
- Channel 4 183.31 ± 3.0 GHz, measures water vapor
- Channel 5 183.31 ± 7.0 GHz, measures water vapor

Observed AIRS Radiances

- channel 705.85 $cm^{-1}$, nadir weighting function peaks near 200mb
- channel 1040.15 $cm^{-1}$, representative of $O_3$ channel
- channel 1109.43 $cm^{-1}$, representative window channel
- channel 1310.18 $cm^{-1}$, representative $H_2O$ channel

## L2 Summary Browse Products

L2 Summary Browse Products represent a twice-daily global snapshot of selected retrieval products thought to be most helpful to the user for deciding which data to order. This browse consists of the following products averaged over a 1x1 degree grid cell:

Cloud-Cleared AIRS Radiances

- channel 705.85 $cm^{-1}$, nadir weighting function peaks near 200mb
- channel 1040.15 $cm^{-1}$, representative of $O_3$ channel
- channel 1109.43 $cm^{-1}$, representative 9 micron window channel
- channel 1310.18 $cm^{-1}$, representative $H_2O$ channel

Geophysical Parameters

- AIRS Retrieved Cloud Cover
- Retrieved Skin Surface Temperature
- Total Water Vapor Burden
- Total Ozone Burden
- MW First Guess Total Liquid Wateronly
- Vis Fraction Clear (Day only)

The daily browse products will have gores between the satellite paths where there is no coverage for that day. Each summary browse product file consists of several unsigned 8-bit arrays. Each array is a 180 x 360 two-dimensional global map of the Earth's surface, at 1degree by 1degree resolution, using a rectilinear projection where each grid cell is bounded by latitude and longitude lines. The longitudinal extent is from -180.0 degrees to +180.0 degrees, with the prime meridian in the center of the image. Each array element has a value between 0 and 255 and is a re-scaled representation of a floating-point number (visible images are integer). The relationship between pixel value (pv) and input floating point data value (dv) is:

$$\mathrm{pv} = \frac{255 \times (\mathrm{dv} - \min(\mathrm{dv}))}{(\max(\mathrm{dv}) - \min(\mathrm{dv}))} + 1$$

The files are in HDF RIS8 (8-bit raster) format and for each image within the file there is an associated color palette. Additionally, for each image there are descriptive annotations in HDF DFAN format. The annotations consist of image title, image description, and the minimum, mean, and maximum of the original data values and the corresponding pixel values. The minimum and maximum of the original data values may be used to annotate a color bar.

# *Sample Data Readers*

## IDL-Based Data Readers

The AIRS Project releases to the broad scientific community sample data readers written in Interactive Data Language (IDL) to facilitate user community use of data products. IDL is an array-oriented data analysis and visualization environment developed and marketed by Research Systems, Incorporated (RSI) of Boulder, Colorado.

The user community must realize that the AIRS Project does not have the resources to support consultation on these readers. They are being provided as an aid to give the user community a leg up in using the data. There is no commitment to provide assistance to the broad user community beyond the release of these readers.

**read_L12_swath_file.pro**

The IDL procedure to read L1B and L2 Product files written in HDF-EOS swath format is provided in the file:

**read_L12_swath_file.pro**

**FUNCTION NAME:**
read_L12_swath_file.pro

**USAGE:**
status = read_L12_swath_file(filename, content_flag,buffer,[content_list=content_list],[swathname=swathname])

**INPUT ARGUMENTS:**

- **filename** - The fully qualified path to a Level 1B or Level 2 HDF-EOS swath data file.
- **content_flag** - An integer that specifies the type of data to be extracted, as follows:
  - 0 - list the names of all data swaths in the file.
  - 1 - list the dimension names and sizes for ONE swath within the file.
  - 2 - list the attribute names and values for ONE swath within the file.
  - 3 - list the data field names and values for ONE swath within the file.
  - **content_list** [OPTIONAL] - An array of text strings which are the names of specific parameters that will extracted per the content flag choice (Choices 1-3 only). If content_list is left unspecified, the function will retrieve the content on ALL items in the category specified by the content_flag.

- **swathname** [OPTIONAL] - A single text expression which is the exact name of the data swath to be extracted from the granule file. If swathname is left unspecified and there is only one data swath in a file, that swath will automatically be used. HINT: Run this function with the content_flag=0 option first if you suspect that there are more than one data swath in a granule file.

**OUTPUTS:**

- standard sucess code, stored in **status** in the USAGE description above
  - 0 = success
  - -1 = failure.
- **buffer** - This is a general-purpose data buffer. When the content_flag=0 option is chosen, "buffer' is a single text expression. When the other content_flag options are used, buffer is an IDL structure which has the results expressed as buffer.<item_name> and buffer.<item_value>. HINT: To query these results, type "help,buffer,/struct" after running this function.

**SAMPLE DRIVER SHOWING USE:**

```
pro get_l2_data
file = ‘<your_path><AIRS_HDF-EOS_swath_filename_ending_in_hdf>’
; read dimensions
status_1 = read_L12_swath_file(file,1,dim_val,content_list=dim_list)
; read attributres
status_2 = read_L12_swath_file(file,2,attr_val,content_list=attr_list)
; read swath data
status_3 = read_L12_swath_file(file,3,l2retstd,content_list=l2retstd_field)
end
```

## read_L3_grid_file.pro

The IDL procedure to read L3 Product files written in HDF-EOS grid format is provided in the file:

**read_L3_grid_file.pro**

**FUNCTION NAME:**
read_L3_grid_file.pro

**USAGE:**
status = read_L3_grid_file(filename, content_flag,buffer,[content_list=content_list],[gridname=gridname])

**INPUT ARGUMENTS:**
- **filename** - The fully qualified path to a Level 3 HDF-EOS grid data file.
- **content_flag** - An integer that specifies the type of data to be extracted, as follows:
  - 0 - list the names of all data grids in the file.
  - 1 - list the dimension names and sizes for ONE grid within the file.
  - 2 - list the attribute names and values for ONE grid within the file.
  - 3 - list the data field names and values for ONE grid within the file.
  - **content_list** [OPTIONAL] - An array of text strings which are the names of specific parameters that will extracted per the content flag choice (Choices 1-3 only). If content_list is left unspecified, the function will retrieve the content on ALL items in the category specified by the content_flag.
  - **gridname** [OPTIONAL] - A single text expression which is the exact name of the data grid to be extracted from the granule file. If gridname is left unspecified and there is only one data grid in a file, that grid will automatically be used. HINT: Run this function with the content_flag=0 option first if you suspect that there are more than one data grid in a granule file.

**OUTPUTS:**
- standard sucess code, stored in **status** in the USAGE description above
  - 0 = success
  - -1 = failure.
- **buffer** - This is a general-purpose data buffer. When the content_flag=0 option is chosen, "buffer' is a single text expression. When the other content_flag options are used, buffer is an IDL structure which has the results expressed as buffer.<item_name> and buffer.<item_value>. HINT: To query these results, type "help,buffer,/struct" after running this function.

**SAMPLE DRIVER SHOWING USE:**

```
pro get_l3_data
file = '<your_path><AIRS_HDF-EOS_grid_filename_ending_in_hdf>'
; read dimensions
status_1 = read_L3_grid_file(file,1,dim_val,content_list=dim_list)
; read attributres
status_2 = read_L3_grid_file(file,2,attr_val,content_list=attr_list)
; read swath data
status_3 = read_L3_grid_file(file,3,l3prod,content_list=l3prod_field)
end
```

## MATLAB-Based Data Readers

The AIRS Project releases to the broad scientific community sample data readers written in MATLAB to facilitate user community use of data products. MATLAB is an array-oriented data analysis and visualization environment developed and marketed by The MathWorks of Natick, Massachusetts.

The user community must realize that the AIRS Project does not have the resources to support consultation on these readers. They are being provided as an aid to give the user community a leg up in using the data. There is no commitment to provide assistance to the broad user community beyond the release of these readers.

**read_L12_swath_file.m**

The MATLAB procedure to read L1B and L2 Product files written in HDF-EOS swath format is provided in the file:

**read_L12_swath_file.m**

**FUNCTION NAME:**

read_L12_swath_file.m

**USAGE:**

buffer = read_L12_swath_file(filename, content_flag,[content_list],[swathname])

**INPUT ARGUMENTS:**

- **filename** - The fully qualified path to a Level 1B or Level 2 HDF-EOS swath data file.
- **content_flag** - An integer that specifies the type of data to be extracted, as follows:
  - 0 - list the names of all data swaths in the file.
  - 1 - list the dimension names and sizes for ONE swath within the file.
  - 2 - list the attribute names and values for ONE swath within the file.
  - 3 - list the data field names and values for ONE swath within the file.
  - **content_list** [OPTIONAL] – A cell array of text strings which are the names of specific parameters that will extracted per the content flag choice (Choices 1-3 only). If content_list is left unspecified, the function will retrieve the content on ALL items in the category specified by the content_flag.
  - **swathname** [OPTIONAL] - A single text expression which is the exact name of the data swath to be extracted from the granule file. If swathname is left unspecified and there is only one data swath in a file, that swath will automatically be used. HINT: Run this function with the

content_flag=0 option first if you suspect that there are more than one data swath in a granule file.

**OUTPUTS:**

- **buffer** - This is a general-purpose data buffer. When the content_flag=0 option is chosen, "buffer' is a comma-delimited text string showing the names of the swaths present in the granule file. When the other content_flag options are used, buffer is a MATLAB data structure in which the results are expressed as buffer.<item_name> and buffer.<item_value>. HINT: To query these results, type "buffer" after running this function.

**SAMPLE DRIVER SHOWING USE:**

```
file = '<your_path><AIRS_HDF-EOS_grid_filename_ending_in_hdf>'
status_1 = 0;
status_2 = 0;
status_3 = 0;

status_1 = 0;
buffer   = read_L12_swath_file(file,1);
if isempty(buffer)
  status_1 = -1;
end
buffer   = read_L12_swath_file(file,2);
status_2 = 0;
if isempty(buffer)
  status_2 = -1;
end
status_3 = 0;
buffer   = read_L12_swath_file(file,3);
if isempty(buffer)
  status_3 = -1;
end
disp(['STATUS ... ', num2str(status_1) ' ' num2str(status_2) ' ' num2str(status_3)])
```

**read_L3_grid_file.m**

The MATLAB procedure to read L3 Product files written in HDF-EOS grid format is provided in the file:

**read_L3_grid_file.m**

**FUNCTION NAME:**

read_L3_grid_file.m

**USAGE:**

buffer = read_L3_grid_file(filename, content_flag,[content_list],[gridname])

**INPUT ARGUMENTS:**

- **filename** - The fully qualified path to a Level 3 HDF-EOS grid data file.
- **content_flag** - An integer that specifies the type of data to be extracted, as follows:
  - 0 - list the names of all data grid in the file.
  - 1 - list the dimension names and sizes for ONE grid within the file.
  - 2 - list the attribute names and values for ONE grid within the file.
  - 3 - list the data field names and values for ONE grid within the file.
  - **content_list** [OPTIONAL] – A cell array of text strings which are the names of specific parameters that will extracted per the content flag choice (Choices 1-3 only). If content_list is left unspecified, the function will retrieve the content on ALL items in the category specified by the content_flag.
  - **swathname** [OPTIONAL] - A single text expression which is the exact name of the data grid to be extracted from the granule file. If gridname is left unspecified and there is only one data grid in a file, that grid will automatically be used. HINT: Run this function with the content_flag=0 option first if you suspect that there are more than one data grid in a granule file.

**OUTPUTS:**

- **buffer** - This is a general-purpose data buffer. When the content_flag=0 option is chosen, "buffer' is a comma-delimited text string showing the names of the grids present in the granule file. When the other content_flag options are used, buffer is a MATLAB data structure in which the results are expressed as buffer.<item_name> and buffer.<item_value>. HINT: To query these results, type "buffer" after running this function.

**SAMPLE DRIVER SHOWING USE:**

```
file = ‘<your_path><AIRS_HDF-EOS_grid_filename_ending_in_hdf>’
status_1 = 0;
status_2 = 0;
status_3 = 0;

status_1 = 0;
buffer   = read_L3_swath_file(file,1);
if isempty(buffer)
   status_1 = -1;
end
buffer   = read_L3_swath_file(file,2);
status_2 = 0;
if isempty(buffer)
   status_2 = -1;
end
status_3 = 0;
buffer   = read_L3_swath_file(file,3);
if isempty(buffer)
   status_3 = -1;
end
disp(['STATUS ... ', num2str(status_1) ' ' num2str(status_2) ' ' num2str(status_3)])
```

# Acronyms

| | |
|---|---|
| **ADPUPA** | Automatic Data Processing Upper Air (radiosonde reports) |
| **AIRS** | Atmospheric infraRed Sounder |
| **AMSU** | Advanced Microwave Sounding Unit |
| **DAAC** | Distributed Active Archive Center |
| **DN** | Data Number |
| **ECMWF** | European Centre for Medium Range Weather Forecasts (UK) |
| **ECS** | EOSDIS Core System |
| **EDOS** | Earth Observing System Data and Operations System |
| **EOS** | Earth Observing System |
| **EOSDIS** | Earth Observing System Data and Information System |
| **ESDT** | Earth Science Data Type |
| **EU** | Engineering Unit |
| **FOV** | Field of View |
| **GDAAC** | Goddard Space Flight Center Distributed Active Archive Center |
| **GSFC** | Goddard Space Flight Center |
| **HDF** | Hierarchical Data Format |
| **HSB** | Humidity Sounder for Brazil |
| **L1A** | Level 1A Data |
| **L1B** | Level 1B Data |
| **L2** | Level 2 Data |
| **L3** | Level 3 Data |
| **LGID** | Local Granule IDentification |
| **MW** | Microwave |
| **NCEP** | National Centers for Environmental Prediction |
| **NESDIS** | National Environmental Satellite, Data and Information Service |
| **NIR** | Near Infrared |
| **NOAA** | National Oceanic and Atmospheric Administration |
| **PGE** | Product Generation Executive |
| **PGS** | Product Generation System |
| **PREPQC** | NCEP quality controlled final observation data |
| **QA** | Quality Assessment |
| **RTA** | Radiative Transfer Algorithm |
| **SPS** | Science Processing System |
| **URL** | Universal Reference Link |
| **VIS** | Visible |
| **WMO** | World Meteorological Organization |